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CURRENT NOTES.

DROUTH IN ALABAMA IN 1884.—The remarkable features for the year were the unusually heavy rainfalls of June and July, followed immediately by a prolonged drought lasting nearly four months. The rainfall was about four inches below the average. The greatest precipitation was along the coast where it was four inches above the average. At Union Springs it was fourteen inches below the average, and at Mountain View near Decatur it was eleven inches below the average. These two sections of the State suffered severely from the drought.—*Alabama Weather Report for February.*

THE CARSON CITY METEOROLOGICAL OBSERVATORY is the private enterprise of Mr. Chas. W. Friend. It has heretofore, for some years, been aided by the State, but a bill continuing this aid at the last legislature was vetoed by Governor Adams and failed to become law. Governor Adams' reason for the veto was that it was of no use to the State. This is short-sighted and indicates a lack of appreciation, and even of intelligence, which would hardly be expected in the governor of a State. We think that Nevada should next time select a governor who would be more appreciative of its best interests. The climate of that State is peculiar and of remarkable interest. It is undoubtedly more true of Nevada than

of any other State that it can not expect a rapid and general development of its agricultural possibilities until its climate is thoroughly understood, and we think that its agricultural possibilities are now underestimated by the general public. The failure of the small stipend from the State will not, fortunately for it, prevent Mr. Friend from pursuing his important work.

A SELENIUM ACTINOMETER.—M. Morize, of Rio de Janeiro, has devised a selenium apparatus for measuring the relative intensities of the rays of the sun at different altitudes of the luminary above the horizon. It consists of a selenium cylinder prepared according to the plan of Professor Graham Bell, 38 discs of copper being isolated from each other by smaller mica discs, and the edges filled in with selenium. It is insulated by glass supports inside a glass envelope from which the air has been exhausted. The vessel is elevated in a place where surface reflection does not reach it, and the axis is placed parallel to the axis of the earth so that the rays of the sun fall normally on the selenium cell and illuminate the same surface. Its position can be altered to keep up this condition from day to day. A constant current traverses the selenium and a galvanometer in circuit with it. From darkness to the most intense radiation of the sun, is the range to be observed, and a scale is graduated accordingly; Clammond's battery is that employed.—*Electric Review.*

EFFECT OF THE PARTIAL SOLAR ECLIPSE of March 16th, 1885, on the readings of the sun thermometer at the New York Meteorological Observatory, Central Park. At midday, just before the commencement of the eclipse, Draper's self-recording sun thermometer of this observatory indicated a sun temperature of 92 degrees Fahrenheit, while the self-recording thermometer in the shade at the same time indicated 33 degrees Fah.

When the obscuration was at its maximum, 1:30 P. M., the sun temperature had fallen to 69 degrees, while that in the shade was still 33 degrees.

At the end of the eclipse, 2:50 P. M., the sun temperature had risen to 82 degrees, and that in the shade to 34 degrees.

It is interesting to note, from the above facts, that one-half of the difference between the sun temperature and that in the shade, at the beginning of the eclipse, is 29½ degrees, while the actual fall of temperature during the eclipse, as shown by the sun instrument,

was 23 degrees. This is as it should be, for only about one-third of the sun was obscured. It is probable that if the eclipse had been total the readings of the two instruments would have been the same. DANIEL DRAPER, Ph. D., Director.

EUROPEAN WEATHER REVIEW FOR FEBRUARY, 1885.—*Barom. Pressure.* From the 1st till the 8th there is a low pressure west of Britain and a high pressure over Russia. On the 9th, however, a maximum appears in the south, and on the 11th spreads over the whole of central and north Europe, uniting with the high pressure in the east; the minimum in the northwest retreats after causing much precipitation and stormy winds over Britain, Norway and Germany; the thermometer on the 12th is below freezing as far west as the northern parts of Holland. The low pressure in the northwest travels northeasterly, and on the 14th is situated near Christiansund (west coast of Norway). On the 15th it takes a northerly course, causing severe storm on the Norwegian coast with snow and freezing weather; snow falls also in north Scotland with northeasterly winds, caused by another minimum approaching south of Ireland. On the 16th the low pressure in the north is divided into two minima, one of which is situated over Denmark, the other hovering near the Norwegian coast, while the low pressure in the southwest spreads over England. On the 18th this depression has disappeared, while that over Denmark travelling in an easterly direction is situated, on the 19th, near Riga on the coast of the Baltic. High pressure with severe cold appears on this date in the north. The minimum on the Baltic coast disappears in the northeast and another appears in the southwest, this however takes a northerly course and hovers, on the 21st, west of Britain, high pressure now spreading over the North Sea, France, western Germany and southern Scandinavia; freezing weather now prevails as far as east Scotland, northern France and Germany; on the 22d the low pressure has considerably increased and taken a northeasterly direction (barometer at Stornoway 28.74), while on the 23d high pressure prevails over France, central Europe and Finland. The low pressure in the west and northwest spreads also to the north, including Finland; causing there unusual high temperatures and stormy weather with continual precipitation over Britain; this state of the weather remains till the 28th, when a high pressure appears in the southwest and the minimum retreats

in a northerly direction. High pressure remains also in the east over Russia.

Temperature—Germany. From the 1st till the 11th, 14th till the 20th, and 24th till the 28th it is above; on the 12th, 13th, and from the 21st till the 23d it is below the mean; highest temperature, at Kaiserslautern, on the 25th, 59°; lowest, on the 13th, at Munich, 11°.

Ireland, Valentia. The temperature is above the mean on the 1st, 2d, 3d, from the 5th till the 14th, and from the 21st till the 28th; it is below the mean on the 4th, and from the 15th till the 20th; highest temperature, on the 10th, 26th and 27th, 54°; lowest, on the 17th and 18th, 34°.

Sweden, Stockholm. The temperature is above the mean from the 1st till the 16th, and from the 23d till the 28th; it is below the mean from the 17th till the 22d; highest temperature, on the 25th, 43°; lowest, on the 21st, 0°.

Russia, St. Petersburg. The temperature is above the mean from the 1st till the 12th, 14th till the 17th, and 24th till the 28th; it is below the mean on the 13th, and from the 18th till the 23d; highest temp., on the 1st, 2d, and 26th, 37°; lowest, on the 22d,—13°.

Lapland, Haparanda. The temperature is above the mean from the 1st till the 14th, and from the 22d till the 28th; it is below the mean from the 15th till the 21st; highest temp., on the 26th, 36°; lowest, on the 19th,—29°.

DR. M. BUYSMANN,
Flushing, Holland.

COLD WINTERS IN MICHIGAN.—Mr. S. A. Jones furnishes us with many interesting facts regarding hard winters during the past 50 years. That of 1836–7 was such a winter. Mr. Jones was then a resident of Ohio, and came to St. Clair county the succeeding spring. The schooner John Hollister, bound from Buffalo for Maumee River ports late in the season, with a valuable cargo of merchandise, was caught near the islands by the arctic wave in December and frozen in, so that her crew were obliged to abandon her. Some time afterward she drifted in to a point a few miles off the mouth of Grand River, and the land pirates along that coast went out on the ice and stole a large portion of her cargo. In the spring the vessel went over Niagara Falls with the ice.

On the 1st of June, 1837, Mr. Jones says, St. Clair River closed up with ice, and the large schooner New York was caught in the ice at Recor's Point and carried down the river. The same year ice was taken out of St. Clair River on the 4th of July.

Between 1837 and 1842–3 the winters were mostly open, that of 1841–2 being especially warm until February 1, up to which time

farmers continued plowing. Snow then came, and for six weeks succeeding there was very fair sleighing.

In 1842 it began snowing the 15th day of November, at noon, and from that time until April 6, 1843, there was no thaw, and the snow lay on the ground to the depth of from three to six feet. There had been a drouth during the latter part of the preceding summer, and crops, especially feed for stock, were very short. This caused great suffering and hundreds of cattle died.

On the 6th of April, "town-meeting day," Mr. Jones went from Marine City, where he then resided, across the swamp to the polling place on the west side, to vote. It was a beautiful day, with a warm sun, and when he returned in the evening the beaten track had softened so much that the horses sank to their knees in the slush. This warm, sunny weather continued, and within a week, or by the 15th, the snow had almost entirely disappeared.

In the spring of 1854 St. Clair River was filled with ice May 1st.

It is interesting in this connection to notice that the local reports of extreme cold winters place them at intervals of between 10 and 11 years, which is the period which astronomers and scientists have found to constitute the cycle of sun-spots, and consequently the period in which the weather upon the earth repeats itself. The winter of 1842–3 is thus shown to have been extremely cold; also the winter of 1853–4; the winter of 1863–4, noted for its terribly cold Newyear's; the winter of 1874–5, when the frost penetrated into the ground in Port Huron four to six feet, there being scarcely a thaw between January 1 and the middle of March; and lastly the winter of 1884–5, which beats the record for extreme cold during January and February.

Another point of interest is this: If certain theories of general meteorological phenomena on the North American continent are correct, a winter of extreme cold after January 1st, in this section, would generally be preceded by drouth or comparatively light rainfall during the latter part of the summer and most of the fall months, in a considerable portion of the country lying east and south of Lakes Michigan and Huron. That was the case last fall, and we are informed that the cold winter of 1842–3 was preceded by an extreme drouth during July and August, and the fall months. The editor of the *Times* will be pleased to receive from any one having records or positive recollections on the subject information regarding the condition of the weather as regards rainfall and drouth during the latter part of the summer and the fall months, preceding any cold winter.—*Port Huron Times.*

TERMINOLOGY OF ATMOSPHERIC VAPOR.—There are several forms of statement commonly met with in describing the occurrence of water in the atmosphere that afford good illustration of the survival of terms after the theories under which they were developed had disappeared. If it were possible, they should be extinguished in the interests of accurate terminology; but the suggestion of new terms is a difficult matter, and the replacement of old terms by new is a long, slow process.

It is often said that air "dissolves" or "holds" water as vapor up to the point of "saturation." It is well known that in a literal sense the air does nothing of the kind; for at a given temperature the same quantity of vapor that can exist mixed with air, may pass into a vacuum and remain there without the presence or aid of air. These terms are relics of the time when air was thought to dissolve water much in the same way that water dissolves salt. If we use the word "air" in a general sense, then it would be better to say that "the air *contains* water vapor," just as it contains oxygen. Saturation has already so well defined and proper a use in describing true liquid solutions, that it would be advisable to use some other word in meteorology, but, unfortunately, it is difficult to suggest any other that is as convenient; and for general use, convenience rather than accuracy will determine the choice. Instead of saying, "the vapor now present would saturate the air at 50°," it would be more precise to say, "the tension of the vapor now present would be the highest possible at 50°." But we can hardly hope to see such a change.

"Latent heat" is another survivor into an age where it does not belong. It is a remnant of an extinct philosophy. When the term was introduced, there was no understanding that heat could be anything but heat, but now it is quite otherwise. As Blanford has written, latent heat is no more heat than the momentum of a moving railway train or the potential combustion of an unignited match is heat. But here again, the convenience of employing an accepted term, even though it imply an error, will for many years keep it in use; it will very likely last after "radiant heat" is replaced by "radiant energy." Would "vapor energy" serve instead? It seems to express what is meant better than "latent heat," which must always suggest an incorrect understanding in the mind of a student; but the analogous term, "liquid energy," suggests another meaning that is objectionable.

The use of the word "vapor" to designate liquid water in a state of extremely fine sub-division is especially unfortunate.

"Water dust" and "ice dust," or their equivalents, should be used when they are meant, unless we are willing to come to such expressions as "liquid water vapor" and "vaporous water vapor." It is unfortunate that we have no special single word signifying water vapor, for it is now as much needed as the word "ice." "Steam" will not do, as it has a limited meaning. "Vapor" will not serve; it is general rather than specific. Connected with this, is the remarkable supposition that the "particles" of water vapor, or the minute cloud particles with which vapor is sometimes confounded, are of vesicular form; that they are minute bubbles instead of drops. This strange idea has come down to us from the seventeenth century, when it was thought even by such men as Halley and Leibnitz, so Whewell tells us, that the hollowness of the minute bubbles would enable them to float in the air. The belief still vaguely persists, but is now more often applied to cloud particles than to vapor; it has gained support from what we must consider the doubtful records of several observers who claimed to have recognized the vesicular structure of floating mist particles under the magnifying glass; but other equally careful and competent observers have failed to discover anything of the kind; it has had the support of writers like Kämtz, Schmid, Clausius and many others; indeed, Clausius claims to have given it mathematical demonstration by his studies on the light of the sky. In spite of this, it seems to have no secure foundation. Apart from the intrinsic difficulty of accounting for the formation of bubbles as against the easy understanding of the growth of droplets, we may quote Lord Rayleigh (*Philosophical Magazine*, April, 1871,) against the vesicular theory: The composition of sky-color is not such as would be produced by interference from the thin films of bubbles; and the direction of maximum polarization of sky light is 90° from the sun, and not 76° as it should be if the illumination of the sky were due to reflection from suspended water bubbles. Lord Rayleigh's papers on this subject are of great interest, and form a valuable supplementary correction to the theory of Tyndall and others that sky-color is due to selective reflection from small particles. We shall be glad to see the vesicular theory disappear from the text books. W. M. D.

ROYAL METEOROLOGICAL SOCIETY.—This society opened its sixth annual exhibition of instruments on Wednesday, March 18th, at the Institution of Civil Engineers, 25 Great George street, S. W.

This exhibition was devoted to sunshine recorders and solar and terrestrial radiation instruments.

The first attempt at obtaining an instrumental record of the amount of sunshine was made by Mr. J. F. Campbell of Islay in the year 1854, when he mounted a hollow glass sphere filled with acidulated water in the centre of a cup of mahogany so arranged that the sun's rays were focussed on the interior of the cup and burned it. The lines of burning therefore indicated the existence of sunshine. Solid glass spheres have been substituted for the hollow ones, and cards in metal frames have replaced the wood; but in its principle the sunshine recorder of 1885 differs little from that erected on Richmond Terrace, Whitehall, thirty years ago. Other modes of recording sunshine are based on the action of the rays of the other end of the spectrum on the actinic instead of the heat rays. Among workers in this direction may be mentioned Marchand of Fécamp, Sir Henry Roscoe and others. The most recent improvements in this direction are those by McLeod and by Jordan.

With regard to solar radiation thermometers, the successive stages in the assumed perfecting of these instruments have been as follows:—An ordinary mercurial thermometer acts as a spherical mirror, and reflects the rays which fall upon it. To lessen this the bulbs were first made with black glass; moreover, originally the degree marks were put upon the supporting slab, then they were put upon the tubes of the thermometers. It was then found that in a position where two thermometers with similarly coated bulbs were exposed to the sun, but one was exposed to more wind than the other, the indicated temperatures varied greatly. To avoid this it was proposed that the thermometer should be inserted in a glass shield exhausted of air. Various forms of mounting have been adopted, but the chief efforts have been expended in determining the influence of the amount of air left in the so-called vacuum. The next stage was, that inasmuch as black glass had a bright surface there was still much light reflected, and therefore the surface was dulled with a coat of lamp black—so that all heat falling upon the bulb might be absorbed. Subsequently, owing to the influence of the lower temperature of the unblackened thermometer tube, about one inch of it was coated like the bulb. As evidence of the degree of exhaustion, a small mercurial pressure gauge was attached to the thermometer, and by other makers platinum wires were soldered through the shield so that the stratification of the electric arc might indicate the amount of air still left.

With regard to terrestrial radiation thermometers the pattern of instrument used has varied very little. The Rutherford minimum has almost always been used, but its sensitiveness has gradually been increased; the spherical bulb was replaced by a cylinder, the cylinder was elongated and bifurcated, and eventually, in order to strengthen the forks, they were united into what is known as a "link." Another plan was to flatten the cylindrical bulb into as thin a plate as possible, this giving a maximum of surface in proportion to the contents. The bulb was also made double, and thus we have the so-called "bottle" pattern, and then the tube was led into the side of the bottle, and both ends of the bottle were left open, and so we have the "open cylinder"—a remarkable specimen of glass blowing. Then there have been two patterns of mercurial thermometers, Casella's and Negretti's. Difficulties have arisen from the degree marks being obliterated by the weather. To guard against this, the tube has been enclosed in what are known as Leach's shields, and many attempts have been made to render the joint at the entrance of the tube water-tight. This is not easy, because the thermometer is exposed to a great range of temperature, and the air inside the shield varies so much in volume that it forces its way through almost every joint. The object is, however, effected when the external jacket is sealed on the stem near the bulb.

In addition to specimens illustrating the various patterns of the above instruments, the exhibition also included a number of new instruments, and many interesting photographs, sketches and diagrams. The photographs of clouds and lightning were very good.

At the meeting of the society the president, Mr. R. H. Scott, F. R. S., read a paper giving a brief account of the various instruments and arrangements to be found in the exhibition, for the purposes of recording solar and terrestrial radiation, and the duration of sunshine both in regard of its light and its heat; the last named being obtained by means of the sunshine recorders which are now pretty generally used. He exhibited twelve monthly maps showing the percentage proportion of hours of recorded sunshine to the hours the sun was above the horizon in the various districts of the United Kingdom. He stated that the features which strike any one on examining the maps of sunshine, which are for the most part for the five last summers and for the four last winters, excluding January to March, 1885, which has not yet expired, are:—*First*, the broad fact that the extreme southwestern and southern stations are the sunniest, as has already frequently been pointed out. Jer-

sey is undoubtedly the most favored of our stations in this particular. *Second*, that in the late autumn and winter Ireland is much sunnier than Great Britain, Dublin having absolutely the highest percentage of possible duration of sunshine in November and December, and being only equaled by Jersey in January. The Dublin instrument is not situated in the city, but at the Mountjoy Barracks in the Phœnix Park, beyond the Vice-regal Lodge. The northeast of Scotland is also exceptionally bright, as the station, Aberdeen, lies to leeward of the Grampians. In April the line of 40 per cent. of possible duration takes in Jersey, Cornwall, Pembrokeshire, the Isle of Man, and the whole of Ireland, except Armagh. The absolute maximum of the year occurs in May, and the amount rises to 50 per cent. (nearly to 60 in Jersey) over the district just mentioned as enjoying 40 per cent. in April. In June there is a falling off which is continued into July and even into August in the Western Highlands. In the south of England, however, a second maximum occurs in August, the figure for Jersey rising to 50 per cent. This is mainly due to the exceptionally bright weather of August, 1884, in the southern counties of England. In September Ireland shows a falling off, and the greatest degree of cloudiness is in Lincolnshire. In October the midland counties of England are the worst off. In November the line of 40 per cent. encloses two districts, one Dublin, already mentioned, and the other the eastern counties (Cambridge and Beccles). The absolutely highest monthly percentages in the period under consideration are in the month of May, 1882, in which St. Anne's Head, Milford Haven, had 62 per cent., while Geldeston (Beccles), Douglas (Isle of Man), and Southbourne (Bournemouth) show 61 per cent.

The exhibition remained open till the 20th inst.

THE OPEN WINTERS OF THE NORTHWEST.—A short time ago the following notice appeared in one of the St. Paul and Minneapolis papers:

Dakota—The Northern Pacific has had no use for snowplows on any part of the line between Mandan and Fargo during the entire winter, the chilling tales of the Dakota blizzard, as told by the eastern press, to the contrary notwithstanding.

This statement attracted our attention, and we wrote to Land Commissioner Lamborn of the Northern Pacific to ascertain the facts in the case.

It is a prevalent, but very erroneous impression that the snow fall is much heavier in the northwest than in other parts of the

country, and that the railroads of Minnesota and Dakota are more liable to delays from snow blockades than the lines of other States. This impression seems to be incorrect. The railroad lines of north Minnesota and Dakota seem really less subject to snow blockades in winter than lines lying geographically several hundred miles to the south. The experience of three winters apparently justifies the Northern Pacific in the claim that its line is the open winter route around the continent.

Below is given the reply of J. T. Odell, assistant general manager Northern Pacific railroad company, to our inquiry:

Colonel C. B. Lamborn, Land Commissioner:

DEAR SIR—Referring to the letter of Mr. Harrington, of the observatory of the university of Michigan, I will say that we have had a little snow trouble this winter, at one point in Montana, temporarily. We also had to run a snow plow from Glendive, on the Yellowstone river, to Dickinson, in Dakota, on three occasions, but no serious trouble was experienced, and the trains that followed the snow-plows made their running time. From Mandan east to St. Paul and Duluth we have not turned a wheel with a snowplow this winter.

In Minnesota and Dakota the snow-fall has been less than usual this season, but in Montana it has been greater than usual.

The country along the whole length of our line was free from snow the latter part of February, and during the first part of March a considerable amount of seeding was done in north Dakota.

I will further state that, at the time the Illinois and Iowa roads were blockaded, the Northern Pacific road was running its trains on regular schedule time, and experiencing no difficulty from snow.

I can safely say, after three years' personal experience, that, with the appliances we use, the Northern Pacific railroad is less liable to snow blockade, throughout its entire length, than the roads in Wisconsin, Iowa, Illinois, Michigan, and even New York.

The snow troubles experienced by our road were not occasioned by the perpendicular fall of snow, but by the high winds forming drifts.

Obstructions have been removed, and buildings which were located on the north side of the track have been removed to the south side; the light cuts have been sloped, and the grass is burned in the fall.

I do not anticipate that the Northern Pacific road will ever again be seriously blockaded by snow. Yours truly, [Signed] J. T. ODELL,
Assistant General Manager.

To this Col. Lamborn adds:

There is no question that the prevalent opinion concerning the snow-fall of the northwestern country and the danger of snow blockades to the railroads in Minnesota and in Dakota is erroneous. Mr. Odell gives the experience of this company during the past winter.

The snow-fall in North Dakota rarely exceeds twelve to fifteen inches in depth, and the delays heretofore experienced have been due to snow drifting in the cuts and the lack of proper appliances to remove it promptly. There is a heavier snow fall in southern Minnesota and Iowa than in North Dakota.

The climatology of the region through which the Northern Pacific railroad runs is an interesting study. The low altitude of the country is in striking con-

trast with the elevations on the lines of the Union Pacific, the Atlantic & Pacific and even the Southern Pacific railroads.

I send you by this mail a blue print copy of the profile of the entire line from Lake Superior to Puget Sound. You will note that at Glendive, on the 105th meridian, the altitude is but 2050 feet, while the line of the Union Pacific at Cheyenne (due south of that point) is about 6,000 feet, and, of the Atchison, Topeka & Santa Fe railroad, at Raton Pass, New Mexico, is nearly 8,000 feet. Helena, Montana, has an altitude of 3,900 feet, and lies almost due north of Salt Lake. The highest point reached by the Northern Pacific is at the Bozeman tunnel, 5,600 feet above sea level, while the altitude of the Union Pacific at Sherman is over 8,000 feet, and of the Central Pacific, at the summit of the Cascade Mountains, is about 7,500 feet.

The depression of the mountain ranges in Montana and the frequency of wide open passes permit the warm air currents from the Pacific Ocean to extend far inland, so that their effect is appreciable eastward to the Missouri valley at Bismarck. The summer season at Bismarck is from three to four weeks longer than at Fargo, in the Red River valley.

We hope at some future time to be able to reproduce the profile mentioned above with some detailed notes concerning the climate. The climate of the high northwest is of especial importance in view of Mr. Sherman's theory.

PREDICTIONS FOR MAY.—The prediction of the weather for some time ahead is of such immeasurable importance that the meteorologist is bound to give a trial to every hopeful case. It is on this principle that we undertake prediction in this number. It is not so much that we expect at present that our predictions will be fulfilled as that by actual test and trial the method will be earliest developed into a practicable and satisfactory one.

The principle on which the predictions will be founded is that laid down by Mr. Sherman in his article on page 248 of the last volume. We anticipate that, though a promising principle, there are variations on it which we do not at present know, but we hope to find them out in due time. The predictions will at first be confined to a small region—southern Michigan or the lower lake region,—should they succeed here we will gradually extend the region predicted on. Mr. Sherman and Mr. Clayton will write out separate predictions and for the present they will be published separately but side by side. Their agreement will be a fair measure of the precision with which the principle involved can be used for predictions.

Although I have increasing confidence in the correctness of the theory of the slow eastward movements of weather areas, I do not think that accurate detailed predictions can be made upon the basis of this theory without the careful co-operation of many

observers, and the collection of a much greater amount of data than is yet available. My observations during April, up to the 24th, (the date on which this paragraph was written) have necessarily been crude and imperfect, but my conclusions are as follows:—Between the 3d and 10th of May a period of comparatively low barometer, with skies much clouded and considerable rain, is likely to open in eastern Michigan. This period will begin several days earlier in the vicinity of Lake Michigan. Following this period closely, probably between the 10th and 18th, I expect the area of cold rains, with much north wind and low temperature when the skies are clear, which is at this date central in Montana, Colorado, Wyoming and western Dakota, to reach the lake region, and continue for some time, very likely until nearly or quite the end of the month. A flurry of snow is quite possible during this period. Beyond this period my observations to the date of this writing do not give any clue to the "probabilities."

LOREN A. SHERMAN.

Between the 19th and 31st of March, I have ten weather maps. On five the area of greatest cold was found in Canada, and on three out of the five near the Atlantic coast—the first time since the beginning of winter it has been so far east. Up to the 15th of April it was found almost continuously in Canada and the lake region, but this area of cold has apparently now passed off the Atlantic coast. The area of warmth has made steady progress toward the east. The January *Weather Review* shows the line separating the places where the mean monthly temperature was above the normal from the places where it was below, running north and south, and lying near the 120 meridian. By February it had moved to the 107 meridian, and the temperature of the whole country to the west of it was above the normal, and to the east below, with the areas of greatest departure + 10° in Washington Territory, and — 14 in the lake region. Data in my possession show that for March it had moved to a little east of Bismarck, or about the 97th meridian; and for April it will probably pass through the lake region. Should the movement continue, as seems probable, it will lie off the Atlantic coast for May and the mean temperature over the whole eastern United States will be above the normal. There are two possible causes of failure, 1st, that the forces in action may have spent themselves, and 2d, that the same forces may tend to produce opposite effects as summer approaches; but everything at present seems to point toward a warm and probably dry May in the eastern United States.

In the last issue, I hazarded a guess as to the weather in the lake region; and it has been fulfilled with considerable accuracy, if not completely. The mean temperature of the first week of the month was above the normal. The cooler period set in rather earlier than was expected; but the temperature remained continuously below the normal till the 18th, with the greatest departures on the 13th and 14th—about three days earlier than was predicted. Since the 18th it has shown a decided tendency upward.

H. Helm Clayton.

Ann Arbor, Mich., April, 24, 1885.

THE COLD ISLAND IN MICHIGAN.

The article contributed to your March number by Mr. S. Alexander on the "Thermal belts and cold island of Michigan," has greatly interested me as being so excellent an example, as its author points it out, of the intimate relation between geological structure, surface form, and meteorological conditions. Many similar examples doubtless exist elsewhere in our country, and when described and illustrated in sufficient detail, they will advance the study of physical geography far beyond its present limits. We have now too often to go far abroad for illustrations that should be sought at home, where they could be equally well found.

The peculiarities of the "cold island," described by Mr. Alexander, come under the heading of "anomalies in the vertical distribution of temperature in mountains," so clearly presented in Hann's *Klimatologie;* and as the explanations there suggested do not fully agree with Mr. Alexander's, I desire to offer the following review of the matter.

The statement on p. 470 of your March number is as follows:—"As the air in the valley becomes warmed by radiation from the earth or any other cause, it becomes rarefied and consequently lighter, and rises to higher levels. The colder air settles down to take its place, thereby causing the difference of temperature between the high and low lands." It seems preferable to say, "the air close to the ground is cooled at night, and then settles chiefly in the valleys." This conclusion may be reached from the following considerations. The average of many observations shows that the normal decrease of temperature upwards in quiet air is about

one degree Fahrenheit for three hundred feet of ascent: any departure from this average must, therefore, be characteristic of some special time or place, or of both. Day and summer time, in temperate and torrid regions, frequently exceed the average, inasmuch as their vertical decrease of temperature is at a faster rate than the above; it generally reaches and passes the limit of unstable equilibrium (1°.6 in 300 feet), as is shown by the increase of the day-time winds and of summer thunder-storms. This excess results directly from the gain of insolation (heat from the sun) over radiation (loss of heat from the earth). On the other hand, night and winter time in all parts of the world show a slower upward cooling, chiefly because the earth is quicker to lose its warmth than the air is. This depends on the physical properties of the air. Air is relatively diathermanous, open to the passage of solar rays, and slow to raise its temperature by absorption; it is equally slow to lower its temperature by radiation: the air at several hundred or thousand feet above us must, therefore, have a smaller diurnal variation than the air near the surface, which follows pretty closely the temperature of the ground; and consequently the vertical decrease of temperature must be slowest at night; the same conclusion holds to a certain extent for the winter season as a whole, and hence all the more strongly for winter nights. At such times it is not uncommon to have the decrease reversed into an increase of temperature upwards for a short distance; the formation of dew or frost without fog shows this in a minute way; the nocturnal frosting of low bushes when higher branches escape untouched, illustrates it on a little larger scale; and when some of our bitter cold winter nights are studied in balloons, still larger examples of the nocturnal inversion of temperatures will probably be found. The winter "foehn," the warm dry south wind felt in the northern valleys of the Alps, and the corresponding winds in other mountain regions, are now clearly shown by Hann's studies, to depend on the slower decrease of temperature vertically in winter than in summer. Woeikof's recent account of the Siberian climate, shows that the excessively low temperatures, for which it is celebrated, are limited to the lower lands, while the higher stations are actually warmer, although, to be sure, cold enough: this must mean that the radiation from the ground through the twenty-four hours so far gains over the weak insolation during the short winter day-light of these northern interior countries, that the lower ground becomes excessively cold and cools the air near it correspondingly, while

the higher air, which is felt on the hills and mountains that rise into it has cooled slower from its own radiation. Thus far, the effects of simple insolation and radiation.

Now, if we consider the effect of mountain and valley surface, it will be apparent that while the mountain at night or in winter feels the upper air that has given off but little of its warmth, the valley becomes for two new reasons a reservoir of cold air. 1st, its days are shorter, and its nights longer than those on the mountain, and in some deep valleys this difference is very marked: 2d, the air cooled by contact with the mountain flanks slides down the slope and accumulates at the lowest spot. I noticed an excellent example of this two summers ago in Montana, when riding late one night across a ridge three or four hundred feet higher than the adjoining valleys; in the low ground the air was damp and raw; in crossing the summit a gentle breeze of distinctly warm air was felt, recalling the temperature of the afternoon.

The "cold island" of Michigan seems to belong with these examples; and in confirmation of the supposition that the anomaly there depends on loss instead of on gain of warmth on the lower ground, I believe more detailed records will show it to be most distinct during winter nights, and absent entirely from the mean of summer months.

Directly connected with this question is the origin of the excessive cold of our anti-cyclonic weather in the winter months. The suggested causes are: 1st, that it depends on the descent of upper air; 2d, that it comes from more northern latitudes in the prevalent northwest winds; 3d, that it results from an excess of radiation over insolation; 4th, that it results from local evaporation. The first of these causes has been advocated by Prof Loomis; but the observations of Hann and Woeikof already quoted do not favor it; and the slow vertical decrease of temperature in anti-cyclones determined on the Puy de Dôme (see p. 375, this JOURNAL), and frequently deducible from the Signal Service records on Mt. Washington are strong against it; for descending cloudless currents such as occur in anti-cyclonic centres must warm by compression 1°.6 for every three hundred feet of descent, and therefore unless the temperature aloft differs from that at the earth's surface by at least as much as $\frac{\textit{difference of altitude}}{300}$ 1°.6 which is very unlikely, the cold of the lower air must be in spite of and not on account of the cold from aloft. If a mass of air could be brought down from

a height of many miles where it is excessively cold, it would become burning hot on reaching sea level.* General considerations would suggest that while anti-cyclonic currents might reduce the temperature in summer, they should raise it in winter; and the departure of actual cases (anti-cyclones are often warm in summer and generally cold in winter) from this theoretic one, implies that the control of temperatures resides in some other cause than the convectional circulation of the winds.

The importation of extreme cold by winds from the northwest is very evidently true in many cases in our latitudes; but it does not explain certain extremely low temperatures that characterize clear and calm winter weather, and the cold in the northwest itself remains to be explained, for it is greater than in the Arctic regions, and hence is not dependent on latitude alone. For both of these cases, the third suggested cause seems more effective than the second. The clear, pure, dry winter air of the far northwest and of quiet anti-cyclonic centres in our own region approaches the condition of no atmosphere, in which the rapid radiation would more than make up for the gain of insolation. The surface of the moon is thus supposed to be excessively cold in spite of being unsheltered from continuous sunshine during fourteen of our days. We may, therefore, safely conclude that our winter cold is greatly increased in anti-cyclonic weather by excessive local radiation, in spite of the descent of air from aloft and we might expect to find the lowest temperature on Mt. Washington when the cold lower air blows up to the summit, cooling as it rises.†

The effect of evaporation is also important. The ground is left more or less moist from the precipitation of the preceding cyclone, and vapor is formed so rapidly in the dry anti-cyclonic winds that follow that they are effectively cooled in the process. What share these various causes have in the formation of "cold islands" can

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* This process gives to my mind a better reason for the burning heat of the simoon than is to be found in the speculations of Palgrave, as quoted in the JOURNAL for April, p. 526. Judging from his statement that, while the simoon lasts, it is necessary to cover the face with a cloth and lie prone in the sand, one may infer that his observations were not very full or precise. The "comparative vacuum" and the "mephitic vapor" are entirely imaginary; but the absence of sand whirls and the violet color of the air were both directly observed. The facts accord much better with the supposition of a clean, pure mass of upper air, descending to the ground, warming as it descends, and displacing the dusty glaring air of the desert surface, than with the idea of cyclonic action, centering in an upward spiral wind that would appear anything but transparent and violet colored, or than with the hypothesis of electric action, which has many supporters.

† Hann has lately said that the excessive cold at low stations accompanies high pressures and calms; while at elevated stations severe cold is found with strong winds, and abnorma warmth occurs in calm weather. (Wein, Akad. Wiss. Sitzungsb., xc 1884; p. 72 of reprint.

hardly be determined as yet; but the question might be approximately answered if a good number of local records of maximum and minimum temperatures were kept in that interesting locality for a few years.

CAMBRIDGE, MASS., March 18, 1885. W. M. DAVIS.

A THEORY OF THE CHINOOK.

In the issue of the METEOROLOGICAL JOURNAL for November, 1884, an article was published entitled "Weather Areas and Their Movements," which set forth the theory that there are certain comparatively slow movements of areas of heat and cold, rain and drouth, across the continent from west to east, which render it possible sometimes to forecast the general character of the weather for some days or weeks in advance. No attempt was made in that article to explain the causes of such movements, nor was it assumed that the observations set forth afforded absolute proof of the correctness of the theory. In presenting some further observations on the subject, and suggesting a theory explaining the cause of these movements, if they do in fact occur, the same reservation is made. I do not claim that the evidence upon any point is sufficient to prove the theories correct, and ask that they be taken mainly as suggestions to students of meteorology who may think this line of investigation worthy of attention.

The "chinook" winds, which are felt with great power in Oregon, Idaho, Montana, and even as far east as Dakota, are familiar phenomena to all students of meteorology. They blow from the northwest, and are so warm that the snow disappears with wonderful rapidity before them. From whence do these winds come, and why do they blow from the northwest, a region of cold? It is assumed, of course, that they must have their origin in the south, but if any probable theory has been presented showing why they should come from a different direction, I have never seen it.

Now let this condition of affairs be assumed: In the arctic regions, during a large portion of the year, the earth is cold, and the air near the surface is steadily rendered frigid and inert. In the equatorial regions, on the other hand, the earth is like a furnace during almost the entire year, and the air near the surface, becoming heated, rises rapidly, its place being taken by currents from the north and south. As we advance northwardly from the equator the heat lessens, but is still sufficient to cause ascending currents

of less power than at the equator, during some portions of the year It follows that the intensely heated and rarefied air in the equatorial regions must rise highest and flow toward the poles, while that heated at the surface in regions further north will rise to a less altitude, and probably flow northward as a sub-current.

Imagine, then, the equatorial current reaching the polar regions and pressing upon the frigid and inert strata of atmosphere near the earth's surface, the tendency being, in a general way, to force it southward. Imagine, again, this mass of inert atmosphere standing like a mountain range facing the south. The great rapidity of the earth's motion eastward at the equator is communicated to the air currents rising from those regions, and as they move northward they also have an easterly motion faster than the earth beneath them, and become southwest currents. The same, it may be assumed, is true of the heated sub-currents rising from semi-tropical regions.

Let us follow such currents in their onward course. Being comparatively near the earth, they come finally to a point where the inert arctic atmosphere presents its mountainous front, and rebounding, become northwest winds, without having parted with any great portion of their heat. At the same time, by friction, they give the arctic air something of an eastward motion.

Now let it be supposed that a powerful sub-current of heated air, perhaps a hundred, probably five hundred, or possibly a thousand miles broad, moves northeasterly across the Pacific ocean and strikes the mountainous coast region of Alaska and British Columbia, backed by the inert mountain of frigid air behind the coast ranges. The result must be to turn the warm currents toward the southeast, and at the same time to open a sort of bay in the arctic atmosphere, and give the whole mass an eastward motion. The "chinooks" may thus be forced down, first upon British Columbia, Washington territory and Oregon, and as the mass moves eastwardly, the bay in the arctic atmosphere growing broader, Idaho, Montana and Dakota will receive the winds, which finally may be felt through to the Atlantic coast.

But while this is going on the heated currents from the equator to the pole are pressing down on the frigid atmosphere at the surface, which moves southward, driving back or under-running the southern sub-currents, until the arctic wave spreads out over a large extent of country, and prevails sometimes for days and weeks. In the mean time the Pacific current again makes its force felt on

the coast of Alaska and British Columbia, and as the arctic wave subsides and scatters to the eastward, the conditions for a repetition of the movement are presented.

There are many other possibilities in this theory, one of them being that the heated sub-currents may arise in eastern Asia, and moving along the coast northwesterly, may meet the arctic atmosphere in the vicinity of Behring's straits. Electrical currents may also play an important part in these grand atmospheric movements, if they really take place.

The presentation of a few facts regarding the weather of the past winter may also suggest minor phenomena pertaining to these movements. It may be assumed, for example, that, as the chinook winds strike the arctic atmosphere with a force somewhat irregular, they communicate to it a wave like motion, and that small portions of it may at first be cut off and forced southward in advance of the main body. It might happen, in such cases, that in certain sections a slight arctic wave would prevail for a day or two, followed by the warm chinook, for a greater or less period, and so on in a succession of cold and warm waves until the arctic movement had spent its force, or the chinook was shattered and dissipated.

During December, 1884, and the early part of January, 1885, the weather was such as to fit into this theory exactly. Severe cold prevailed in Oregon, and in Washington, Idaho, Montana and Dakota territories, while further east the force of the last chinook wave was still felt. In Michigan there were occasional "cold snaps," but they did not last long, showing that the warm currents were still contending for the mastery. But toward the middle of January the cold periods grew stronger and more frequent, and during the latter part of the month the cold was steadily severe. Twice, at least, early in February, there were signs of a warm wave from the west, but within a few hours the arctic wave asserted its power again, and the signs of warmth disappeared. In the mean time another chinook wave had forced itself into the territories as far east as Montana, where the weather had grown warm and the snow had disappeared in the valleys, while even in bleak Dakota a decided modification of the temperature was observable early in February. On the 14th of February there was a depression in the arctic wave, extending from Dakota to the lower lakes, and the chinook wind swept through it, bringing, on Sunday, the 15th, the first thaw for a month. But a powerful cold wave was still behind, and on Monday, the 16th, it forced the chinook upward again, and increased in size and strength until the temperature went to 25°

below zero on the night of the 17th. But this was the last exhibition of power on the part of the great arctic atmospheric flood that had prevailed in the lake region for a full month. After the 17th the weather grew steadily warmer, and within a week there was a thaw which continued, with slight intermissions, until the 7th of March. Then the edge of another arctic wave made its appearance, the chinook was again forced upward, and from the 15th to the 22d brought some of the coldest weather ever felt in Michigan in March.

It should be mentioned that the arctic wave which prevailed in Montana and Dakota in December and early in January, and reached Michigan about the middle of January, did not make itself felt at New York city until about February 1st, and allowed Massachusetts farmers to continue their plowing until the close of the first week in February.

It may be surmised that the Pacific chinooks are largely the rain-bringing winds of the North American continent, as the south Atlantic winds are of Europe. They come to our western shores laden with moisture, or bringing the electrical conditions which produce precipitation, not in all cases, perhaps, but usually. Note their effect. In winter, crowded southward by the arctic atmosphere, they strike the coast of California and cause abundant rains. As spring advances, and the great arctic billow rolls eastward, they are not turned back until they have reached a point much further north. In summer they may proceed unopposed nearly to the arctic circle before they are deflected to the southeast, and their influence is but little felt between Oregon and the Mississippi River.

Look over the weather charts and notice the tracks of low barometer and areas of precipitation. During the summer months the region west of the Mississippi is comparatively rainless, although it may be covered with tracks of low barometer. The lake region, also, which has a surface atmosphere comparatively cool, and over which the chinooks may pass at a considerable elevation, has a much lighter annual rainfall than the Ohio valley, where there is no cold strata to keep the chinooks from approaching the surface.

As to the eastward movements of areas of rain and drouth during the spring, summer and autumn, let this condition of affairs be imagined: A belt of chinook currents three hundred miles broad has forced itself upon the western coast and moved eastward. We find it, say in April, bringing abundant rains to Dakota, while in Michigan scarcely any rain falls. It has scattered the arctic atmos-

phere far north into British America, leaving for the territory south of it such temperature and weather as the direct rays of the sun may bring it. Steadily this belt moves eastward, and although areas of low barometer may arise far to the westward and sweep through it to the Atlantic coast, but little rain falls outside the territory where its immediate influence is felt. To the southward, however, it spreads out like a fan, giving to that entire region more regular and abundant rains than fall in the Northwest and the interior of the continent.

This belt having passed, a period of comparative drouth prevails, lasting a month, perhaps, and sometimes more, and west of the Mississippi, not infrequently, during the remainder of the season. Periods of drouth during the summer, it is well known, are marked by stagnation in the atmosphere, showing that the heat, and all other meteorological phenomena, have a local origin. But after a time another chinook belt, which has perhaps been moving eastward through British North America for a month, frequently circling entirely around Dakota, and perhaps Minnesota, sends its breath into the Mississippi valley, moves eastward over the lake region, and pursues its course through to the Atlantic coast.

Supposing these theories to be well-founded, and the crude observations which have led to their formulation to be demonstrated facts, no difficulty will be found in accounting for the minor and local phenomena throughout a large portion of the North American continent. Mountain ranges, table lands, the Great Lakes, the valleys of great rivers and forest regions, all exercise a large influence in shaping the weather locally. During the warm season we find most of the areas of low barometer originating in regions west of the Mississippi where the direct rays of the sun heat the earth and atmosphere undisturbed by foreign winds, and local currents are thereby set in motion which soon widen into extensive disturbances. In regions swept by winds originating at distant points such disturbances seldom originate, and as the whole eastern portion of the United States is generally under the influence of the scattered chinooks, or of the disturbances originating in the interior of the continent, it takes its weather second hand at nearly all seasons of of the year.

There are some other observed facts, and many other suggestions arising therefrom, that may be embodied in a subsequent article, should the readers of the JOURNAL find this one of sufficient interest to demand it.

LOREN A. SHERMAN.

THE DEFLECTIVE EFFECT OF THE EARTH'S ROTATION OBTAINED BY QUATERNIONS.

In order to separate this effect, we will consider the motion of a body under the influence of gravity and the normal re-action of the earth (π) *only*.

Then (α being the vector to it) we have

$$\ddot{\alpha} = \frac{-\alpha}{T\alpha^3} + \pi \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Since it moves on the surface of an ellipsoid,

$$S.\alpha\varphi\alpha = 1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

whence, differentiating, $S.\dot{\alpha}\varphi\alpha = 0$ . . . . . (3)

We do not exclude an initial velocity, it must be remembered. But let α_0 be vector of a point having the same position (but at rest on the surface), as $\dot{\alpha}$ has at a given moment; i.e., $\alpha = \alpha_0$ at that time. We must find $D_t^2(\alpha - \alpha_0)$.

$$\text{Now, } \ddot{\alpha}_0 = \frac{-\alpha}{T\alpha^3} + \pi_0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where π_0 is the pressure of the earth on the point at rest.

$$\text{Thus, } \ddot{\alpha} - \ddot{\alpha}_0 = \pi - \pi_0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

If j be taken any vector in the tangent plane, and therefore perpendicular to the direction of π,

$$Sj\pi = Sj\pi_0 = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

$$\therefore\ Sj(\ddot{\alpha} - \ddot{\alpha}_0) = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

Applying the formula $D_t S\alpha\beta = S\dot{\alpha}\beta + S\alpha\dot{\beta}$ . . . (8) to (7) twice, we have (since $S(\alpha - \alpha_0) D_t^2 j = 0$),

$$-D_t^2 Sj(\alpha - \alpha_0) = -2S(\dot{\alpha} - \dot{\alpha}_0) D_t j \quad . \quad . \quad . \quad (9)$$

If the earth rotate about λ, its axis, with angular velocity ω,

$$D_t j = \omega V\lambda j \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

and

$$-2S(\dot{\alpha} - \dot{\alpha}_0) D_t j = -2\omega S(\dot{\alpha} - \dot{\alpha}_0)\lambda j \quad . \quad . \quad (11)$$

To find the value of this, take i in the direction the motion happens to be, j perpendicular to it in the tangent plane, and k perpendicular to both, and therefore in direction of normal. Let φ be the complement of the angle the normal makes with λ (very nearly $\varphi =$ the latitude). Let

$$\lambda = i \cos\varphi \cos\theta + j \cos\varphi \sin\theta + k \sin\varphi \quad . \quad . \quad . \quad (12)$$

$$\dot{\alpha} - \dot{\alpha}_0 = v\, i \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

where v is the initial velocity;

$$\text{then } - D_t^2 S j\,(\alpha - \alpha_0) = -2\omega \begin{vmatrix} v & 0 & 0 \\ \cos\varphi\cos\theta & \cos\varphi\sin\theta & \sin\varphi, \\ 0 & 1 & 0 \end{vmatrix} \quad (14)$$

$$\text{therefore the deflection} = -2\omega . v . \sin\varphi \quad . \quad . \quad . \quad . \quad . \quad (15)$$

The $-$ denotes rotation opposite that of nearest pole. It may be similarly shown, that, in the direction of the instantaneous velocity, there is no acceleration.

$$- D_t^2 S\, i\,(\alpha - \alpha_0) = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

The wrong solutions of this problem generally arise from not distinguishing between $(\dot{\alpha} - \dot{\alpha}_0)$ and $D_t\,(\alpha - \alpha_0)$, or $(\ddot{\alpha} - \ddot{\alpha}_0)$ and $D_t^2\,(\alpha - \alpha_0)$.

CAMBRIDGE, MASS. ALFRED C. LANE.

THE "STORM GLASS" AND ITS ACTION.

It was discovered by our ancestors that the height of the undissolved camphor in a camphor bottle was different in different states of the weather; and it became quite customary to keep a camphor bottle in sight in order to anticipate the change in the weather, it being thought that an increase in the height of the camphor indicated approaching rain or wind. The inventive genius of our age could not long allow the instrument to remain in this crude form.* The camphor† and alcohol were put into long glass tubes hermetically sealed at the top and adjusted in a frame with a thermometer attached. The side of the frame next the tube was divided into three divisions. On the bottom one was marked the word "Fair" on the middle one "Change" and on the top one "Storm." A note accompanying the instrument stated that the

* The first improvement was, I believe, made by Admiral FitzRoy.

† Other ingredients besides the camphor, I believe, are now included. I find it stated that two parts camphor, one part nitrate of potash, and one part salammoniac are put into the alcohol and a little water added.

weather was indicated by the word in the division with which the top of the chemical substance corresponded. It also stated that the direction of the wind was shown by the substance being a little higher on the opposite side from which the wind came. These were manufactured and sold all over our country under the name of "Storm Glasses," or "Chemical Barometers." One firm, I suppose in order to increase the sales, adopted the name of "Signal Service Barometer;" and I have met a number of people in possession of these instruments who really thought they had one of the genuine barometers which the Signal Service used in its predictions.

The fact that the manufacturers have hermetically sealed the top of the tubes fortunately assists in an investigation of the cause of the instrument's action, for it is evident at once that the contents of an impermeable, air tight vessel of glass can neither be affected by variations in the atmospheric pressure or moisture. That light is not the cause of its action can be easily shown, for the chemical substance varies in height in the dark just as it does in the light. Neither can its changes be due to the action of the electricity of the air, for the changes in the tube take place the same in a protected shelter as they do in the open air, and the electric potential inside of a shelter is always zero.* We turn to changes of temperature for the cause of it variations, and find a most satisfactory explanation of its action. If it is winter, one can easily convince himself of this by taking the instrument into a warm room. After a time a large part of the white precipitate will disappear. If now the instrument be hung out of doors, the precipitate will in a little while increase greatly in quantity, and, if the difference of temperature is considerable, the alcohol in the tube will be filled from top to bottom. I have a tube on which I have divided the length from the top of the alcohol down to the bottom into ten parts, and these again into ten parts, so that I can read the height of the precipitate at any time in hundreds of the greatest height to which it is possible for it to extend. March 24th, I found the instrument hanging in my room read 21 on the scale, temperature inside of room 73°, outside 27°. I placed the instrument outside, and in two minutes little stars began to form at the side and to move down toward the bottom and up to the top again in the center of the tube. These continued to increase in size and in five minutes the alcohol was about one quarter full of them. As these

* I exposed an instrument for fifteen minutes to an electrical machine charged to high potential and no change whatever took place in the height of the column in the tube.

increased and the circulation of the liquid became slower, they began to accumulate at the bottom and somewhat at the top, until in twenty minutes the alcohol was full from top to bottom. I brought it inside the house and in a few minutes the precipitate began to take on a more attenuated appearance and to slowly decrease in height. In forty minutes it read 21 again. Readings of the height of the precipitate taken every ten minutes were as follows:—4:55 P. M. 100, 5:05 P. M. 93, 5:15 P. M. 80, 5:25 P. M. 50, 5:35 P. M. 21. Another instrument with a scale arranged in exactly the same manner had been hanging outside for a month or two and read 50 during the whole experiment. The instrument in my room was next put into warm water, and I found that at a temperature of about 100° every particle of the precipitate would disappear.*

If allowed to remain in the water while it cooled, little stars or flakes would begin to appear in the alcohol, and when it had fallen to a temperature of 70° or 75°, the alcohol would be entirely filled with the precipitate. If, then, the indications of the instrument are to be relied on it is easy to get up a storm on short notice.

Suppose when an instrument has been carried out of a warm room and the precipitate fills the alcohol from top to bottom, that it is left outside, as was done on the first of January with the instrument hanging outside referred to above. In such a case after the instrument has been out sometime, the column of precipitate will begin to shorten, even though the temperature remains the same; and it will be noticed that the bottom presents a more compact appearance. After about a week or ten days, the precipitate will have entirely lost its feathery appearance, except, perhaps, a little at the top, and will present a compact granulated mass filling about half the tube, if it is winter, and about one quarter, if it is summer. If while the column of precipitate was shortening there was any considerable change in temperature there might be some minor oscillations in the length of the column but the whole tendency would be downward. When this state is attained, the precipitate dissolves very slowly in the alcohol, and the instrument is capable of going through considerable changes in temperature without much change in the height of the precipitate. Thus suppose in the morning the temperature was 40°, and by noon had risen to 50°, the height of the column may show no perceptible decrease, because the dense crystals dissolve slowly, and the alco-

* In order to make it dissolve rapidly it is well to shake it up before putting it in water.

hol lacks considerable of containing as much as it could dissolve at the latter temperature; but when towards night the temperature again falls to about 40°, the liquid is nearly saturated; and, if by the next morning the temperature has fallen to say 32°, the liquid will be filled to a considerable height with light feathery crystals which readily dissolve on a rise of temperature, or if the temperature remains stationary settle to the bottom changed into the more compact granular crystals. To illustrate from observation—on Jan. 13 the temperature in the room for about a week had been ranging from about 60° to 70°, and the height of the precipitate in the instrument had been almost steady at 23 on the scale, when the temperature in the room on the evening of the 13th fell to 52° and light flakes of precipitate began to form. I knew the liquid was now supersaturated, and any further decrease in temperature would cause a decided precipitation. On the morning of the 14th the temperature had fallen to 43° and the height of the column of precipitate was 32 on the scale. I observed the instrument inside the house and the one outside three times a day during January and February, and it was always found that the height of the two columns varied in opposite directions whenever the temperature changes inside and outside were in opposite directions. The following is an example:—

Date.	Time.	Temp. in room.	Height of precipitate.	Temp. outside.	Height of precipitate.
Jan. 16.....	9 P. M.	42°	56	16.5°	58
" 17.....	7 A. M.	47	53	6.5	58
" ".....	2 P. M.	59	34	17.0	58
" ".....	9 P. M.	52	30	2.0	59
Jan. 18.....	7 A. M.	50	28	−7.0	72

I observed the instrument three times a day during the whole summer and autumn of 1881, and there was never an increase in the height of the precipitate without a corresponding fall of temperature, or a decrease without a corresponding rise of temperature. It will thus be seen that the instrument is not a "Storm Glass" or a "chemical barometer," but a chemical thermometer, and a very poor thermometer at that.

Do its indications bear any relation to weather changes? Yes! because temperature changes are closely related to other weather changes. In the summer under an extended, but moderately high pressure area, or anti-cyclone, there usually exists beautiful, fair, warm, settled weather, and the top of the precipitate will be even with the division marked "Fair." When showers come on, the air turns cooler and the precipitate rises to the division marked "Change." Whenever an area of decided low pressure passes over the country, the air is warm in front of it; and as the center passes over, there is usually a sudden fall of temperature. This causes the precipitate to rise up to the division marked "Storm," and the wind in such cyclonic systems is always high, especially in their rear. In the winter the top of the precipitate is nearly always up in the division marked "Change," and as the weather is eternally changing, I suppose it may be considered about right. On the contrary a decided anti-cyclone may in summer bring cool weather; and the precipitate will rise up into the division marked "Storm," accompanied by the clearest skies and delightful breezes. It is also common for rains to pass over without any material changes in temperature. In such cases the height of the precipitate will remain unchanged. The indications of the instrument are then sometimes right, sometimes wrong, like the negro's dumb watch which was always right twice a day, but, as it gave no indications of the time when it was right, it was not worth much as a practical instrument.

H. HELM CLAYTON.

FREAKS OF THE FROST.

An examination of the fruit trees in this vicinity has shown that the severe cold of the past winter has done great damage. Most of the peach trees in this locality are killed, and this is probably the case over the entire State. The frost has played some curious pranks while committing its depredations. In fact it has violated all our notions concerning its methods of performing. Heretofore we have always supposed that its effects were most severe on young trees, or on the young and succulent growth of old trees; but such has not been the case this time. It has most seriously damaged the *old trees*, and not the *tops* or *young growth* of them so much as it has the trunks between the limbs and roots; the branches and young shoots of last year's growth remaining, in many cases,

entirely green and seemingly uninjured while the bodies are completely dead.

In years past we have considered deep snow around the bodies of trees a protection to them. Such, however, has not, in most instances, proved to be the case this winter. In many places where the snow has covered the trees to the depth of twenty inches or more, the bark, cambium and outer layer of wood have been frozen until they have turned black. This is particularly the case with the earlier varieties; but these effects are not confined very closely to varieties. Although natural trees are considered more hardy than budded ones, they have not proven themselves exempt from injury by cold during the past winter. In some instances a tree will be killed while another of the same kind, one rod away, and with the same exposure, will be entirely unharmed. Very many young trees of one year's growth are uninjured, contrary to all precedents and expectations. Apple trees, also, have suffered serious damage from splitting in consequence of freezing. The loss to the State from the killing of fruit trees during the past season has been very great.

It may also be noticed that, in consequence of the intense cold of the last two winters, the field mice and meadow moles have been nearly destroyed by starvation, freezing and smothering.

BIRMINGHAM, MICH., Mar. 15, '85. S. ALEXANDER.

THE INVERSION OF THE WIND'S DIURNAL PERIOD AT ELEVATED STATIONS.

As early as 1839 Mr. Osler proved from the hourly observations of preceding years at Birmingham, England, that the force of the wind was greatest at 1 P. M., and that its diurnal strength varied nearly with the rise and fall of the thermometer during each season. In 1857 it was also shown from the anemometric self-register of the Liverpool Observatory that the force and, therefore, the velocity of the wind was less at night than during the day, the minimum velocity, which averaged 11 miles per hour, occurring at 1:30 A. M., and the maximum velocity, averaging 14.8 miles per hour, at 1:30 P. M. Prof. Loomis, in his *Meteorology* states that at Philadelphia the mean force of the wind is least about sunrise and greatest about 2 P. M., the pressure at noon being fully double that at midnight.

Such being the facts at low elevations, let us look at the diurnal variation of the wind at higher altitudes. Prof. E. D. Archibald, in summing up the results of his experiments with anemometers attached to kite strings (*Nature*, No. 786), says: "There is no doubt that, if observations should be taken every hour, a distinct diurnal variation between the velocity at two given heights would be observed, the velocity at the greater altitude probably tending towards a minimum about the same time that the velocity at the earth's surface reached its maximum. This would, however, only be the case when the heights were about one thousand feet or more." Such observations have been made for Pike's Peak, Colorado, 14,134 feet above the sea, and for Denver, 5,294 feet elevation. and are quoted by Mr. H. A. Hazen (*Report of the Chief Signal Officer* for 1882, part 2, p. 17), who says concerning them: "The fact that the maximum at Pike's Peak occurs at 5 A. M., while that is very near the time of the minimum at the base, may be explained on the principle that the continuous upper current is not retarded by an upward rush of air in the morning, while this uprush producing the maximum at the base in the afternoon acts as a check to the upper current." An inspection of the table referred to shows that the minimum difference between the velocities on Pike's Peak and at Denver occurs about 2 P. M., supporting the theory of Dr. Köppen mentioned hereafter. On the top of the Säntis, in Switzerland, 8094 feet high, it is found (*Bericht über die Errichtung der Meteorologischen Station auf dem Säntis und ihre Thätigkeit.* Sept., '83—Aug., '84. R. Billwiller, Zurich, 1884) that the wind usually reaches its lowest velocity about midday and its highest about midnight, being just the reverse of what occurs at the earth's surface beneath. Peruker (in his *Beitrag zu den Windrerhältnissen in höheren Luftschickten.* Sitz-Ber. d. Kaiserl. Akad. Mathem. Naturw. Kl., Vienna, 1884; Bd. xc) states that three months' records of the self-registering anemometers upon the peak of the Hochobir, 7052 feet above the sea, show that there is a double maximum of the wind's velocity between 5 and 6 A. M. and 10 and 11 P. M., and a chief minimum between 2 and 3 P. M. Concerning the wind upon the summit of Ben Nevis, in Scotland, Mr. Buchan says (*Journal Scot. Met. Soc.*, 3d Series, No. 1): "In each month the maximum velocity is during the night and the minimum during the day, being the reverse of what occurs at low levels and on plains. The difference between the hour of greatest and the hour of least mean velocity is from 4 to 5 miles."

Now, since Ben Nevis is but 4,400 feet high, it seemed to the writer that the above should be equally true of Mt. Washington, nearly 2,000 feet higher, and on the occasion of a recent visit there, he was able to prove it from the Signal Station records for the year, at least so far as the mean velocities were concerned, in the following manner. The mean monthly velocities at 11 A. M. and 11 P. M. were averaged, which gave the mean hourly velocity as 34.3 miles at the former time and 37.9 miles at the latter, a difference of 3.6 miles in favor of the night observation. This difference varied from more than 7 miles in the summer to nothing in the spring. To investigate the matter further, the total movement of the wind recorded in the eight hours included between 7 A. M. and 3 P. M. for the day, and for the eight hours between 11 P. M. and 7 A. M. for the night, was averaged, eliminating many months, when on account of frost work on the anemometer cups the movement was regarded as insufficient. In this way the day velocities were found to be 32.2 miles per hour and the night velocities 34.6 miles per hour, giving an hourly excess of velocity at night of 2.4 miles over that of the day.

Pursuing the same course, for the sake of comparison with the records of the Boston station, the average velocity at 11 P. M. was found to be 9.8, and at 11 A. M. 11.5 miles, the maximum difference occurring in May and the minimum in December. The average hourly movement during the so-called night hours was 11.8 and for the daylight hours was 13.9 miles, giving an excess of velocity during the day over that of the night of 2.1 miles and completely reversing the conditions found on Mt. Washington.

It having been objected that Boston was not a suitable station to use for these comparisons, on account of its proximity to the sea and the possible disturbing influence of land and sea breezes, a year's records of Burlington, Vt., were examined, this being the nearest inland station to Mt. Washington. From these records an average excess of velocity of 4.5 miles for the 11 A. M. observation over 11 P. M. observation was found, the maximum excess being 4.6 miles in July and the minimum 0.3 mile in November. The average excess of velocity during the day over the night was 2.1 miles an hour, this last being exactly the same as for Boston.

That the plane of the inversion of the wind's diurnal period may not be at a high altitude is proved by comparing the observations made during February last at Boston with those conducted at the Blue Hill Observatory, which has an elevation of 640 feet or less

than 500 feet more than that of the Signal Station in Boston, from which it is distant ten miles. The mean day velocity at Boston was 13.7 miles and the night velocity 13.3 miles, while the figures at Blue Hill were, respectively, 20.2 miles and 21.1 miles, giving a difference of velocity in the former case of 0.4 mile in favor of the day, and in the latter 0.9 mile in favor of the night.

Now for a more detailed explanation of the apparently anomalous action of the wind at high altitudes. Consider the condition of the atmosphere at night. It is chilled near the ground; the lower strata of air, held by friction with the earth's surface, lie relatively still, while the overlying winds whose motions are caused by seasonal, and not diurnal differences of temperature, continue their course. But the day conditions are different. As Dr. Köppen (in the *Zeitschrift der östreichischen Gesellschaft für Meteorologie* for 1879) says: "The expansion of the lower strata by solar action during the day causes an intermixture of the air to take place between the upper and lower layers, by which the velocity of the lower layers is increased by the greater velocity which the descending air brings with it from above, while the upper layers have their velocities decreased by the smaller velocity with which the ascending lower air, retarded by the asperities of the earth's surface, is endowed. Thus, while the mean velocity of the atmosphere might remain the same, the difference between the velocity above and below should undergo a diurnal period, the minimum difference occurring somewhat after midday." It is interesting to note that this same theory was suggested by one of our most distinguished early American meteorologists, Mr. J. P. Espy, who, in his *Philosophy of Storms*, published in 1840, says: "The commencement of upmoving columns in the morning will be attended with an increase of wind and its force will increase with the increasing columns; both keeping pace with the increasing temperature. This increase of wind is produced partly by the rush of air on all sides at the surface of the earth towards the centre of the ascending columns, producing fitful breezes; and partly by the depression of air all round the ascending columns, bringing down with it the motion which it has above, which is known to be greater than that which the air has in contact with the asperities of the earth's surface."

From a table in No. 795 of *Nature*, giving the percentage of diurnal variation from the mean in the winds' velocity on Ben Nevis, Säntis and Mt. Washington in summer, and on Ben Nevis in win-

ter, the editor finds that the maximum occurs on these heights shortly after midnight and the minimum shortly after noon. "Now it will be seen that those diurnal maxima and minima occur nearer midnight and noon than do the phases of the other meteorological phenomena, thus suggesting a direct connection with solar and terrestrial radiation. It is singular that while the diurnal period of strongest insolation determines the occurrence of the maximum velocity of the wind over extensive land surfaces, it determines the minimum velocity on peaks rising to great height above the land surfaces surrounding them."

On Ben Nevis (unlike Mt. Washington, as indicated by the figures previously given) the curve of the diurnal variation of the wind's velocity is said to be as clearly marked in winter as in summer (though the data for this statement are not apparent) and two curves are stated to be alike in showing the occurrence of the maximum velocity shortly after noon, notwithstanding the practical uniformity of temperature in winter of the surface of the top of Ben Nevis, caused by the clouds and fog which generally cover it. Therefore the editor of *Nature* concludes "that the peculiar type of the diurnal curves of wind velocity on these elevated peaks is altogether independent of the surface over which the winds blow. These results point not obscurely to an investigation of the relations of visible and invisible vapor of the atmosphere to solar and terrestrial radiation as an inquiry of the first importance in meteorology."

In concluding this article, which the writer hopes will call the attention of American meteorologists generally to the subject and provoke discussion, it seems worth while to mention a somewhat curious illustration of the inversion of the wind's diurnal period on the open sea. Prof. Winslow Upstan in his *Report on the Solar Eclipse Expedition to Caroline Island*, in 1883, noted the hourly speed of the ship, always under sail, during the voyage from Callao, over the constant conditions of the South Sea, with reference to a diurnal change in the wind's velocity, and found that the means for the speed showed a faint maximum for 11 P. M., and a minimum for 11 A. M., with unexpected regularity. Now, it is thought among sailors that a ship's sails fill better at night, which, perhaps, has for its reason that at night the pores of the canvas are filled with moisture, causing the wind to have a greater effect upon the sails at night than in the day-time, which is suggested as a possible explanation of this abnormal inversion of the wind's diurnal period.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory, Readville, Mass.

THE HURON TORNADO OF AUGUST 28, 1884.

The photograph of this tornado has directed general attention toward it. There seems, however, to be a very general doubt as to whether or not the photograph is authentic. I think this doubt is not justified, and in support of this opinion, I here give the essential parts of some correspondence with regard to it. The letters were not intended for publication, but I give parts of them in the words of the writers so that they may not have attributed to them anything they did not say. The first is from Gen. W. H. H. Beadle, superintendent of Public Instruction in Dakota. He says under date of November 7th, 1884:

"In the JOURNAL for November, just opened by me, I observe two notices of a Dakota tornado, or series of tornadoes, rather—for such they were—that occurred Aug. 28, 1884. I have heard the description from fifty different persons—all alike, and that on pages 242–4 of the JOURNAL is correct, but inadequate. But I write expressly to say that I will, in a few days, put you in possession of an actual photograph of the tornado, taken at Howard, Miner Co., Dakota, at a distance of 22 miles from it. I have no copy left, but will to-day order one for you.

Beyond Mr. Rupert's description it may be added that the tornado first appeared a few miles north-northwest of Huron; passed that place, as he describes, when it crossed Dakota river; passed down the east side of the river, and again crossed to the west side in Sanborn county; crossed to the east side again, and passed southeasterly, ending near the southern part of Hanson county, or in Hutchinson county—a total distance of 75 to 85 miles.

There was a series of funnel-shaped clouds formed in this route, and it was not all pursued by the single one described by Mr. Rupert. New ones formed at different places somewhat aside from the line between the beginning and end. Sometimes there were two or three partial ones besides the main one, and the photograph shows two such. One would expend its force and another become fully developed. The path of destruction was narrow, but the force was terrific. The destruction of life was considerable. The day was oppressively warm. We had, for some time before, prevailing southeasterly winds and increasing heat. The course of these winds was very nearly the reverse of the line upon which the

tornado moved. After the tornado passed we had cooler northwesterly wind. We were in that time when our autumnal windy period begins. This is fairly uniform in our seasons; when the winds from the equatorial regions toward the pole descend to the earth, and the belt in which they so descend recedes toward the south with cooler weather (following the sun) and they are followed more and more by northwesterly winds which in turn prevail until spring. At that time the movement is reversed.

The tornado was caused by the meeting of these currents, both high or deep and powerful. The scene was an open prairie and in a wide smooth valley, that of the Dakota. The winds from the south bore off toward the northwest and the north wind toward the southeast, with the northwest wind the more powerful and heavy, the other more rare and weak. Along the line between the two the tornado was formed just as whirlpools are at the margin of currents in water. This may not be scientific, but it appears to be just the way it occurred; I am not even an amateur meteorologist of a low grade, but have lived 16 years, largely outdoors, upon these plains, and have observed the weather, and some of its apparent laws.

Again, the question occurred, how high was the tornado cloud, that is the one from which the elephant's trunk descended? The picture is at a distance of 22 miles, and the cloud must have been over a mile high. At Huron it was observed by Hon. Cortez Fessenden, U. S. Surveyor General (formerly of Michigan), and C. H. Cameron, his chief clerk. They estimated the cloud to be at an angle of 45 degrees elevation at a certain time, and they later found that the tornado was then striking the ground under the cloud at a distance of one and a half miles from them. It was therefore a mile and a half high. Other evidence agrees with this. When the tornado last crossed the Dakota river it took the water clean and plowed a wide furrow in the mud.

This much I have written in a few minutes, rapidly, upon reading your notice.

I was not in sight of the phenomena, but saw the clouds and felt the change of air that followed. Having since been over the ground I was so far interested as to learn these facts."

The following is still more specific as to the authenticity of the picture, and gives moreover many interesting details. It is from Edgar L. Larkin, director of New Windsor Observatory, New Windsor, Illinois. Under date of November 8th, 1884, Mr. Larkin says:—

"Seeing on page 240, METEOROLOGICAL JOURNAL for November, your request for account of cyclone in Miner county, D. T., I take pleasure in mailing you the enclosed account and photographs. A miller went from this place to Howard City, Miner county, D. T., to build a flouring mill. He was an eye-witness of the cyclone and assisted the artist in carrying camera. He returned a few days since, bringing these two photos to show to me. I saw your note in the JOURNAL, and hastened this A. M. to borrow the photographs, which find enclosed with my compliments. They *must* be *returned* to me by mail without fail. I also send a cut of Howard City—which you may keep—upon which, from description, I have drawn a line representing as well as possible the path of the storm from its appearance near Carthage, 18 miles northwest of Howard, until it vanished in the southwestern horizon. The storm was seen from Howard City in the direction of Carthage at 2 and disappeared at 4:30 P. M., having been visible from Howard 2½ hours. The day was hot and without wind, and even while the cyclone was passing Howard at its nearest approach, 2 miles, no wind could be felt in the village. Absolute stillness prevailed, and the usual roar was not heard. The storm was without lightning or electrical display of any kind. In the largest photo we see first the prairie, next clear sky and above this the cloud with the cyclone standing like a column from the earth to the cloud. The bottom of the cyclone was 20 feet in diameter, the top being estimated at 60 feet. Yet, the bottom cut a swath 66 feet wide, moving everything within this narrow belt. This was caused by a whirling motion like that I here endeavor to make clear thus:—

The dotted lines represent tongue of cyclone in different positions. In each gyration, like a conical pendulum, it would pass through all points in a circle, two of which are at A and B—the radius of circle while passing Howard being 33 feet generally. Sometimes three columns, at others two, and at still other times one only would be visible.

In the small photograph we see two complete and a third in process of formation. In large photo may be seen one large column which is the central one in the small picture fully developed; while to the right and left are remnants of complete cyclones in small picture, in process of ascending into cloud whence they came. In the lithograph of Howard City enclosed you will observe that at intersection of Howard avenue and Main st., I have marked position of camera, and two miles westward is designated position of

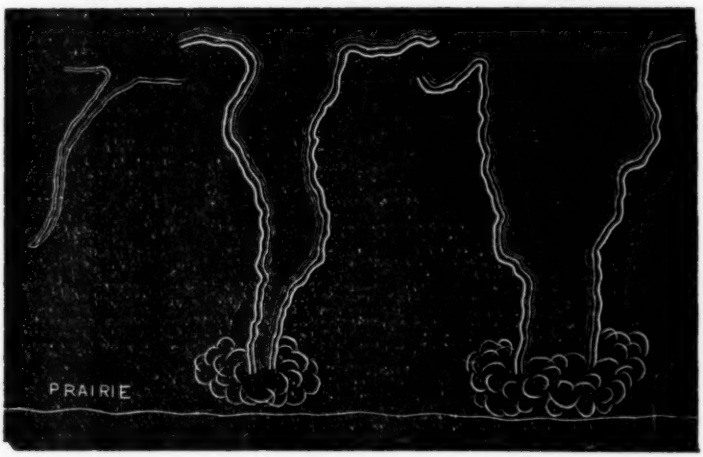
cyclonic column at instant photograph was taken. The miller was standing by side of camera while picture was being taken, and he says, exposure was instantaneous.

He describes his sensations while viewing the storm to be similar to what he has read about as being experienced at times of earthquakes. The villagers have "cyclone caves" and opened them to be in instant readiness, but happily the apparition did not take the town. The farm house and barns seen to the west, 3 miles, were demolished, and 30 cattle killed. At another point a boy and two teams of horses were instantly killed.

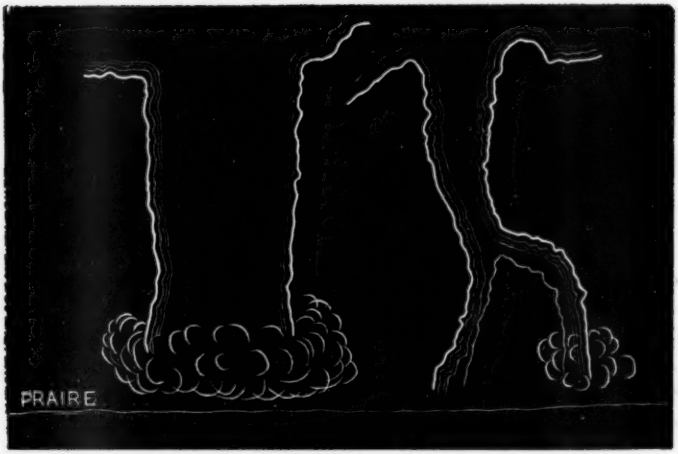
Immediately after column passed Howard, rain fell in immense quantities, the water, in entire absence of wind, falling straight down in streams. Temperature high during rain, but upon clearing thermometer fell decidedly. To me these photographs are most interesting, since they are the *only* photos of a cyclone ever taken. These two negatives are all the artist obtained, and if engraved and published in your JOURNAL will doubtless awaken interest in scientific circles. The miller tells me they are *not* copyrighted and that anybody is free to use them. I hope you will publish them in the METEOROLOGICAL JOURNAL. The owner tells me if they are returned in 30 days he will be satisfied.

At C, D, the railroad was bent into a semi-circle, by sliding along the ties. Radius of curve about 30 feet. Drawing, made by young lady in Howard, eye-witness, enclosed."

No. 1. No. 2. No. 3.



No. 4. No. 5.



No. 1 did not touch the ground. Nos. 2, 3 and 4 are different aspects at intervals. No. 5 is as it disappeared in the southwestern horizon at 4:30 P. M., Aug. 28, 1884. The marks at bases of cyclone are dust and grass ascending and whirling. Drawn by a young lady at Howard, D.T.

In a letter dated November 13, Mr. Larkin adds:—"The 'miller' tells me that Mr. Robinson might have secured another negative, but that he was almost unable to manipulate through fear, the monster at that moment coming directly toward the centre of Howard. How would you like to *observe* under such circumstances?"

Another picture, a "tin-type," was taken of a part of the same series of tornadoes, by J. C. Judkin, from Huron, as they were passing southeast of that place. From Huron it is reported that "Several people were killed, and great destruction done to property. Near Huron several buildings were caught up, pieces of which were afterwards picked up 20 miles away. At Briggs' near Forestburg, 30 head of cattle were killed. Near Diana two persons were killed. Loss of life and property reported at various other places."

This picture mysteriously disappeared while in the charge of the engravers. It was, in essential respects, like that taken from Howard.

M. W. HARRINGTON.

April 3, 1885.

THE EUROPEAN POLAR SEA.*

We have received some particulars of the voyages of the Norwegian seal and walrus hunters in 1884, which not only give an excellent general idea of the state of the ice in what is called the European Polar sea during the past season, but are also of considerable geographical value. The observations of these hardy and intelligent seamen are always interesting, even in ordinary seasons, because they enable us to keep a continuous record of the movements of the ice in a highly important section of the threshold of the unknown region. Occasionally, however, some unusual meteorological conditions render them of special consequence, and this was the case last year. It is necessary to give a brief sketch of the principal statements before their true significance can be appreciated. Capt. G. A. Sorenson, of the William, found that in the middle of May the west side of Spitzbergen was rendered inaccessible by a belt of ice extending forty miles from the land. Outside this belt he saw open water in every direction. Following the edge of the ice to the northward, he found that the belt decreased to a breadth of twenty miles at Amsterdam island, which he succeeded in reaching, but as the north side of Spitzbergen was much incumbered by ice, he again sailed southward on the 20th of May. The belt was then less compact off Prince Charles foreland, but the William had to put into Ice fiord to avoid a heavy pack off the entrance, and was shut in until the 15th of July. Sorenson then sailed southward in open water, only finding loose ice off the various inlets, and reached South cape on the 16th of July. On the 18th of August he sailed through Helis sound, and ran toward King Karl land in his steam cutter, seeing hardly any ice to the north, east, or south, but on attempting to sail through Hinlopen strait he found it blocked by ice to the north of Ice cape.

Capt. Johan Kjeldsen, of the Tvende Brodre, was off the west coast of Spitzbergen on the 25th of June, and found it blocked by a belt of ice which was then from eight to twelve miles broad. He was able to follow the edge of the belt to the northward and eastward without much obstruction from drift ice, and reached Mussel bay on the 16th of July. A northerly wind then brought the ice into the bay, and, though open water could be seen beyond it from the crow's nest, the Tvende Brodre was unable to escape, and was nipped and sunk on the 20th of July. Three days later two other vessels which were lying in the bay met with the same fate.

The "jagts" Freja and Ornen reached the north side of Spitzbergen some time before Kjeldsen, and entered Hinlopen strait about the end of June. Here a succession of gales from the north and northwest brought the ice down upon them, and for a whole month they were beating about among the floes. On the 30th of June both vessels were crushed, and the crews consisting of twenty-six men, escaped by dragging their boats over the ice and following the leads until at last they reached Stor fiord, by way of Walter Thymen or Freeman strait, and were picked up by some of the other sealers.

H. C. Johannesen, who commanded the Lena in Nordenskjold's famous expedition, left Tromso on the 3d of May and on the 3d of June fell in with ice about 120 miles northwest of Vardo, in latitude 72 degrees north and longitude

* From the Chicago *Times*, reprinted from the London *Times*.

30 degrees east. He reached Kostin island on the 13th of June, and sailed northwestward along the coast of Nova Zembla in an open channel between the land and the pack which lay from twenty to twenty-five miles off shore. On the 11th of July he reached Admiralty peninsula, but here the pack rested on the land and prevented any further advance. The ice now began to close in upon the coast before a strong westerly wind, and Johannesen therefore decided to follow the pack edge toward Spitzbergen. He found the pack still down to latitude 72 degrees 50 minutes north, in longitude 46 degrees east, to 73 degrees 50 minutes north, in 38 east, but he was then driven to the southwest by a northwesterly gale, and did not reach Edge island until the 7th of August. The most important part of Johannesen's voyage, however began on the 15th of August, when he sailed from Ryk Ys islands toward King Karl or Wiche land, among loosely scattered drift ice, and approached to within twenty miles of the land. He then sailed eastward, keeping the south side of King Karl land in sight, to latitude 78:30 north and longitude 34 east, from which position he saw two hitherto unknown islands extending eastward as far as the eye could reach. They appeared to him to consist of table-topped mountains, partly bare and partly covered with snow. On the 21st of August he steered toward Barent island, and then to the northwestward, finding open water in every direction, and anchored in Hinlopen strait on the 26th of August.

Capt. H. Andreassen, of the sloop Elieser, accompanied Johannesen when he sailed to King Karl land, and on the 20th of August was about twenty-two miles from the land. The next day he steered in a northeasterly direction, toward the third island until he was in latitude 78:24 north and about longitude 36 east. He was about eighteen miles from the land, and right opposite the sound between the second and third islands. The southwest point of the third or easternmost island appeared to be fronted by several small islands. The atmosphere was clear and the sky cloudless. The second island appeared to be separated from King Karl land by a sound twelve miles broad, and the breadth of the strait between the second and third islands was estimated at about four miles. These two newly discovered islands form with King Karl land a group extending from southwest to northeast, or east-northeast which so far as could be seen is terminated by the third island. The second island is described by Andreassen as somewhat smaller than King Karl land, forming a single dome-shaped highland. The third island is about equal in size to King Karl land, and forms a high plateau with precipitous slopes to the southwest and northeast. During the next few days Andreassen sailed around the west point of King Karl land, and from the north side of the island he thought he could distinguish another island to the northeastward, which in that case must lie north of the easternmost of the new islands, and may be the so-called White island.

From these statements it is evident that in some respects 1884 was a remarkable ice-year. In the first place, the west side of Spitzbergen was blocked by a belt of land-ice the whole summer through, whereas it is open as a rule from the earliest commencement of that season. The oldest sealers do not remember such a late year in this respect. On the other hand, the sea east of Spitzbergen, which is nearly always blocked with ice was more open than it has been for many years, the exceptional season of 1872 when King Karl land was landed on for the first time since its discovery by the English in 1617, being the only one known that can compare at all with it. The cause of these unusual conditions is not far to seek. During the spring and summer, southwest, west and northerly winds prevailed on all sides of Spitzbergen, so that the ice was packed on the west and north coasts,

while it was cleared away from the seas to the south and east, and massed on the west side of Nova Zembla, and in all probability between the group and Franz Josef land. It is true that the north side of Spitzbergen was somewhat more accessible than the west side, but the dangerous condition of the ice was only too well exemplified by the loss of the vessels in Mussel bay and Hinlopen strait. The southern edge of the east Spitzbergen ice was only 120 miles from Vardo so late as the 3d of June, and though an examination of the complete journals shows that it lay somewhat farther north between the 15th and 25th of that month, yet even in the beginning of August it was as low as latitude 73 degrees 50 minutes north, longitude 38 degrees east, while the eastern edge of the pack only left a "land water" on the west side of Nova Zembla as far north as Admiralty peninsula. Eastward of Northeast land, and in the vicinity of King Karl land, the sea was almost free from ice all through the month of August. Under these circumstances, the majority of the sealing vessels naturally sought the eastern fishing-grounds, with the result that two of them reached a position that has never before been attained by a vessel.

As we have said King Karl land was trodden by man for the first time since its discovery in 1872, when Capt. Nils Johnsen anchored off the northeast point of the island, and climbed the hill which crowns it. The position of this point was charted from Johnsen's observations, and also those of Capt. Altmann, who sailed along the coast in the same season, as being in latitude 79 degrees 10 minutes north, longitude 32 degrees 20 minutes east. Since then no vessel has been able to approach the island until last year, when Johannesen and Andreassen not only followed the whole of its south side, but also sailed some distance to the eastward, Johannesen to 34 and Andreassen to 36 degrees east longitude, when, under favorable conditions of light and atmosphere, they discovered the new islands of considerable size. The description given by both Johannesen and Andreassen of King Karl land agrees with that of Prof. Mohn, although Johannesen is inclined, for several reasons, to place the western extreme of the island the so-called Swedish foreland, at least one degree further east. And it is probable that all three islands belong to the same geological group, the southern coast line of which extends in an east-northeast direction from Cape Tordenskiold to about latitude 79 degrees 20 minutes north and longitude 38 to 39 degrees east, the estimated position of what appeared to be the northeastern extreme of the eastern land.

It may seem a little strange at first sight that when Johnsen was on the northeast point of King Karl land on the 17th of August, 1872, he saw no land to the eastward, though the sound between that point and the first of the two new islands is said to be only twelve miles broad. But when questioned on the subject, he stated that though the weather was fine it was somewhat hazy; and this, together with the strong refraction which is common in high latitudes under such circumstances, would be sufficient to account for his not seeing the land. One of Andreassen's crew, who was with Johnsen in 1872, has also been questioned as to this. He states that while the weather was quite hazy enough to obscure the land in 1872, it was peculiarly favorable last year to distant observations in every direction, owing to the prevailing southwesterly winds. In these seas all winds from west to north and northeast usually bring foggy weather, while southwesterly winds are accompanied by clear weather and a bright sky. Then, bearing in mind the fact that in 1872 King Karl land was described as forming three prominent hills which looked like separate islands until a closer approach showed that they were connected by low land, it was thought that this might possibly account for the two islands discovered last year, and that they might after all be only the two eastern

hills on King Karl land. But both Johannesen and Andreassen have been repeatedly and closely questioned on this point, and they positively affirm that no such mistake could possibly have occurred. Johannesen reached longitude 34 degrees east and was therefore east of the northeast extreme of King Karl land, and from this position saw high land extending as far east as he could see from his vessel. Andreassen reached a point still further east, whence he could see the open sound between the two new islands. The description given of the outline and appearance of the land also precludes the idea that it could have been mistaken for any part of King Karl land. There still remains the fact that King Karl land was actually circumnavigated early in August, 1872, by Capt. Nilsen, and though his track, as shown on Prof. Mohn's chart, does not agree with his journal, there is no doubt that he passed the eastern point of the island at least once, without seeing land to the eastward. It appears, however, from the chart that he kept close to the land all the way, and was consequently at the greatest distance possible from the new island on the other side of the sound; and, as in Johnsen's case, the view might have been obscured by haze. On the whole, there seems to be no ground whatever to doubt the reality of the discovery. Both Johannesen and Andreassen are experienced Arctic navigators, and both are well known as sharp and reliable observers, while it may be added that their statements are fully and unaminously corroborated by their crews.

These new islands having thus been fairly brought within the sphere of practical geography, it becomes necessary to consider the question of nomenclature, and it is right that we should point out the claims of our own countrymen to have a voice in the matter. King Karl land was, as I have said, first discovered in 1617, when the golden days of the Spitzbergen whale-fishery was at its height, by one of the bold adventurers of the Muscovy company. The discovery is thus recorded in Purchas, the name of Greenland being still applied in those days to the Spitzbergen group:

"In the yeare 1617, the company set out for Greenland fourteene sayle of ships, and their two pinnasses, furnished with a sufficient number of men and all other provisions fitting for the voyage, under the command of Thomas Edge . . . They employed a ship of sixtie tunnes, with twenty men in her, who discovered to the eastward of Greenland, as far to the northward as seventie-nine degrees, an iland which he named Wiches iland, and divers other ilands as by the map appeareth, and killed store of sea-horses there, and then came into bel Sound, where he found his lading of oyle left by the captayne, which he tooke in. This yeare the Hull men set a small ship or two to the eastward of Greenland, for the Hull men still followed the steps of the Londoners, and in a yeare or two called it their discoverie, which is false and untrue, as by oath in the admiraltie doth appeare. The Dutch likewise practice the same course."

Wiche's land was never seen again, or at least delineated on a map until 1870, when the Baron von Heuglin sighted an extensive land on the eastern horizon from a hill on Edge island. He believed this to be a discovery, and to be part of a great continent, and his belief was shared by Dr. Petermann, who accordingly discarded the old and true name of Wiche's land and christened it King Karl land. The text of Purchas, however, plainly tells us that the discovery ship went as far north as "seventie-nine degrees," and as this is the exact latitude of the large island sighted by Von Heuglin, it is thus conclusively proved to be identical with the Wiche's land discovered by the English in 1617. It was probably named after Mr. Richard Wiche, an eminent London merchant, who was one of the founders of the East India Company. The claims of all parties might be reasonably met by applying the name "King Karl land" to the whole group, the

western island to have its proper name restored and be called Wiche land on all new maps, while the two new islands would, of course, be dealt with by the Norwegians.

Before taking leave of this subject it may be well to point out that the voyages of the Norwegian sealers in 1884 remind us once again of the impossibility of forecasting the movements of the ice in any one year, and if the report is true that the expeditions to be sent from America and Denmark this year are to push their explorations in about the same direction, we can only say that it seems a pity to risk so much on a single throw. At all events, it would be very unwise for either expedition to decide finally upon the route to be adopted until the time arrived for leaving the last European harbor, say at the end of July or early in August. By that time it would at least be possible to form a rough idea of the general movements of the ice in the European Polar sea by a careful study of the prevailing winds during the spring and summer as recorded at some of the northernmost stations in Norway.

THE TORNADOES IN ALABAMA ON JANUARY 11, 1885.*

The following extracts culled from the report of observers and reliable newspaper articles will be read with much interest. By an examination of the accompanying map it will be noticed that this violent disturbance of the atmosphere was divided into three distinct tornadoes, one passing through North, one through Middle and the other through Southern Alabama.

NORTH ALABAMA TORNADO.

Lamar County.—About 5 P. M. on January 11th, a storm passed two miles north of Vernon. Its trace was from a quarter to a half a mile in width, coming from the southwest and taking a northeasterly course about 15° north of east. It demolished two dwellings near Vernon, and destroyed some other houses in the county; no lives were lost so far as known.

Fayette County.—The day was warm and showery, with a south wind; not much electricity noted until just at night, when the clouds began to gather black and heavy in the southwest, and the thunder increased in frequency and violence. The clouds changed from black to a greenish color, and the wind began to blow with great force from the southwest. It is reported that the storm did not rush forward with a uniform rate of speed, but rose and fell, bounding from side to side like a ball. It was preceded, attended and followed by a heavy rain, but no hail. The thermometer stood at 58° during its passage.

The storm passed eight miles north of Fayette Court House about 5:30 P. M. It swept through the northern portion of the county and great damage is reported along its course. Twelve plantations were devastated between Luxapilila creek and Sipsey river; one person was killed and several seriously injured; several families lost everything but life, stock was killed or maimed, dwellings and outhouses were torn to pieces, orchards ruined, timber and fencing demolished and all household goods scattered in every direction. A heavy sill from one house was carried a quarter of a mile and planted upright in an orchard. After crossing

* From the report of the Alabama Weather Service for January by P. H. Mell, Jr., director of the Service.

the Sipsey the storm followed the course of Barren creek, destroying everything that came in its way. The damage to timber was immense. It passed over into Walker county near Eldridge. This tornado followed nearly the same track as the storm last year in early spring. We have no reports from Walker county beyond Eldridge.

Cullman County.—The storm crossed the track of the L. & N. R. R. about 45 miles north of Birmingham. There was great destruction of timber; and near the Warrior river two dwellings were blown down, and the inmates severely injured. The tornado still maintained its northeasterly course, 15 degrees north of east.

Blount County.—About 7 P. M. the storm passed through the northern portion of Blount county between Brooksville and Summit. The width of the track here was about three-fourths of a mile, and everything fell before it; trees were torn up by the roots, fences were scattered, ten dwellings were utterly demolished, many stables, corn-cribs, &c., were levelled to the ground and stock killed or injured. One family lost everything. A number of persons were seriously hurt but no one was killed.

Marshall County.—No record is given of the course of the storm in this county until it approached the neighborhood of Albertsville, where we learn that besides destroying much property, it also killed one man and wounded another.

DeKalb County.—After leaving Albertsville, the course of the storm changed almost due east, passing below Crossville and apparently over Collinsville. Three residences were blown down, two persons killed, several injured, and great damage reported to have been done to farm property generally. The tornado was noted at Collinsville about 8 P. M., and was attended by incessant lightning and continuous roaring like distant thunder, that was heard thirty minutes before the storm came. The appearance of the storm was terrible. During the whole day and a greater part of the night there was a very heavy rainfall. The temperature for the day ranged 55° to 60°. It is said that an anvil was blown from a blacksmith's house and carried some distance. One house was torn instantly to pieces and the inmates hurled in every direction, forty or fifty yards, and a child killed by flying timbers. Every post was drawn out of the ground, and the chickens were killed and even stripped of their feathers. Another dwelling that was swept away contained thirteen occupants, all of whom were injured, but no one fatally hurt. The track of the tornado in DeKalb county was two hundred yards wide.

MIDDLE ALABAMA TORNADO.

Greene County.—"On last Sunday night, the 11th inst., a tornado swept across the southern portion of this county, carrying death and destruction in its path. The day had been showery and unusually warm for the season. About dark a heavy rain, accompanied with thunder and incessant lightning, fell over a broad belt of country on both sides of what proved to be the subsequent path of the storm. Quite early in the night Mr. Charles Willis observed an unusual phosphorescent glow in the southwest and called the attention of others to it as a phenomenon resembling a sunrise in the night. The tornado seems to have originated in this county at or near the Tombigbee river, as we have no accounts of it from beyond that river. Soon after the disappearance of the luminous glow witnessed by Mr. Willis, Dr. A. Bird observed three intensely black clouds, of sugar-loaf shape, advancing rapidly from the southwest. The two outer ones moved in a line with each other at an apparent distance of a quarter of a mile

apart. The third one followed at a small distance in the rear, the three forming the angles of a huge hollow triangle. All these clouds were seething and boiling as if convulsed with violent internal forces. The spaces between them glowed with intense electrical corruscations. The three rapidly moving clouds, the electric flashes and the thunderous roar of their swift rush through the heavens formed a sublime and dreadful spectacle. It was this roar coming out of the southwest and approaching nearer and nearer that attracted the attention of so many of the citizens of Eutaw and filled them with apprehension that a cyclone was approaching the town. The roar passed rapidly towards the northeast and gradually died away in the distance. The heavens were ablaze with incessant lightning along the path of the receding storm.

The tornado, as is often the case, seems to have formed and advanced a considerable distance at some elevation above the surface of the earth. The three funnel-shaped clouds, when first observed by Dr. Bird, were not touching but leaning towards and rapidly approaching the earth. Their first point of contact with it, was at Hohenlinden, where a small outhouse was demolished. The three clouds seem to have coalesced at this point and the more than giant strength of the storm was fully developed. Half a mile east of Hohenlinden it struck the Powell Place, demolishing most of the buildings, uprooting or tearing to pieces the stoutest trees, prostrating fences, maiming stock and killing a horse. A negro woman was killed by the timbers of a falling house, and when taken from the ruins, her infant child, still clasped in her arms, was found to be alive and unharmed. From this point the storm, now a quarter of a mile wide, swept through a dense grove leaving scarce a tree standing in its path. Skirting the buildings on the Martin place and doing little or no damage except blowing down the fences, it struck a narrow belt of timbered land about two hundred yards west of the residence of Mr. S. Q. McAlpine. The largest trees were either uprooted or snapped in two and shivered into fragments. The residence of Mr. McAlpine, flanked by numerous outhouses and located on a small eminence, immediately east of this timbered belt, stood, unfortunately, in the very center of the path of the tornado, and was exposed to its utmost fury. The ginhouse was demolished and its timbers and contents scattered in all directions. A few bales of cotton lying outside of it were hurled a considerable distance along the pathway of the storm. Every negro cabin was destroyed. Corncribs, fodder houses, stables, tool houses, wagon sheds and cattle covers were swept clean away, the fodder hopelessly lost, the corn scattered and every tool, farming implement and vehicle of every description shivered into pieces or blown away. The kitchen and the store room, with all their contents were irrecoverably scattered. The dwelling house, built of stout logs, double roomed below and above, with a dining room attached, was demolished down to the basement floor and the entire contents of every description driven into fragments or scattered far and wide over the adjacent fields. Mr. McAlpine and his children, with only a few bruises, passed unharmed through the tremendous ordeal. And strange to say, not a single human being, nor a single animal perished on his place, though many of each were more or less seriously injured. In all the history of tornadoes we have never read of such complete and universal destruction of houses and their contents. Literally not one brick or log or plank of a once comfortable home was left upon another. The scene was one of utter ruin and desolation.

The work of destruction accomplished, the storm swept on, destroying the cabins and killing a negro boy on the W. S. Bird plantation, unroofing cribs and outhouses on the Lightfoot place and demolishing many of the out buildings of Dr. J. W. Clements.

It then passed into Hale county, and we trace its path by the press dispatches through many counties in Alabama, marked at every stage of progress by the killing or mutilation of persons and animals and great destruction of property.

By far the greatest sufferer from the tornado in this county was Mr. S. Q. McAlpine. His home with all its equipment and surroundings was utterly destroyed.—J. W. TAYLOR."

The track of this storm in Greene county was one quarter of a mile wide, and its course was about north 78° east. It passed seven miles south of Eutaw through a number of plantations carrying destruction throughout its extent.

The storm crossed the Warrior river from Greene and Hale county one quarter of a mile north of Stephens' Bluff, where the destruction of timber was immense.

Hale County.—The storm entered this county about 7 P. M. It crossed Warrior river about eight miles below the crossing of the Alabama Great Southern Railroad, thence passed east of northeast midway between Greensboro and Green Springs over about thirty miles of the country. Its course was about 25° north of east. The track of the storm was a mile and a half wide. It left but few houses standing in its course; only the best built dwellings resisted its force; nearly all outhouses in its track were blown down and their timbers widely scattered.

Immense tracts of forest lands were most seriously damaged; their largest and best timbers being prostrated and piled together in tangled masses. Some roads were so blocked that it took days to clear them. No lives were lost in this county, though many persons were severely bruised. Cotton bales weighing 500 lbs. were carried from a quarter to a half a mile without serious damage. Two strongly built country churches were blown down, Mt. Hebren and Five Mile. The electrical display attending this storm was magnificent. The barometer at Greensboro located within a few miles of the center of the storm indicated its approach by a fall of 0.56 of an inch in twenty four hours, and during the next forty-eight hours, it rose 0.70 of an inch. The thermometer at the same place was 66° at 9 P. M. The rain was not unusually heavy.

Bibb County.—The storm entered this county just above the Perry line; its course was almost due east, passing below Centerville and near Randolph. Its path was a mile wide and great damage was done to the houses, fencing, timber, &c. The rainfall was copious but not remarkably heavy and the lightning incessant. Houses a mile or two away from the track of the tornado shook as if in an earthquake. Thousands of trees were felled, and the roads rendered impassable. One person was killed, and one injured; several were badly bruised and some stock was killed.

Chilton County.—Between 8 and 9 P. M. a tornado passed half a mile north of Jemison doing considerable damage to timber. The sides and roof of a house near Jemison were blown away, leaving the family seated in their chairs unharmed. Some trees were blown across a railroad track and a freight train was derailed. The path of the tornado was three hundred yards wide in the central and most violent section, and its power extended over about three hundred yards on either side also, making a track nearly a thousand yards wide.

The thermometer at Clanton, about ten miles south of the track of the storm, was 62°.

Coosa County.—The path of the storm in this county was at least twenty miles long, passing Marble Valley, Mt. Olive and Goodwater. Its immediate track was a half of a mile wide destroying everything. Its direction was from

west to 20° north of east. Five miles north of Mt. Olive the destruction of property was very great. Sixteen farms were devastated; the public roads were blocked. No one was killed but many narrow escapes were made, and some persons were seriously injured. The storm passed two miles north of Goodwater at 9:15 P. M. The day there had been quite warm. The morning was bright and clear with south east wind but it soon began to be cloudy, with the wind blowing from the south and about 10 A. M. the first rain fell. The remainder of the day was showery; about 3 P. M. the wind began changing around into the southwest; and broken clouds moved rapidly from that direction. About 7 P. M. there were indications of an approaching storm, both by the appearance of the clouds, and by an indescribable feeling produced by the atmosphere. The tornado was accompanied by continuous vivid lightning, heavy rain, and a roaring sound like a coal burner, the peals of thunder rising above this roar like the report of a cannon. Hail fell on the north side of the track while the storm was passing. Upon examination of the path the next day at Goodwater it was found that while the destruction was very great along the whole track, it seemed to be worse upon the northern side. The trees on the south side were nearly all lying in the direction of the storm, while on the northern line they were piled in confusion, the fences seemed to be lifted up, shaken to pieces and dropped back again on the ground. In several places on the north side there seemed to be secondary whirls independent of the main one, particularly when the track crossed very broken ground. Occasionally, one hundred and fifty or two hundred yards away from the main storm, isolated spots would be found from half an acre to two acres in extent with every tree uprooted, and piled in confusion. One life was lost and several persons were injured—two seriously.

This storm was about sixteen miles north of the one that occurred a year ago in this county, and a mile and a half north of the one occurring May 1st, 1876.

Clay County.—The storm continued its work of destruction, blowing down houses near Pinkneyville, passing through the southern portion of this county; one man was killed near Hillabee, and his wife injured, and a few others wounded. Great damage to timber is reported.

Randolph County.—The tornado passed between Wedowee and Roanoke, killing two persons and blowing down a great many houses.

SOUTH ALABAMA TORNADO.

Macon County.—In this section the day was warm, cloudy and showery, but there was no electricity and nothing alarming in the character of the clouds. Late in the afternoon the clouds began to gather in the west and to look dark and threatening; the wind freshened and lightning was noticed for the first time. About 11 P. M. a tornado struck that part of the county known as Little Texas, situated about 11 miles east of Tuskegee. The storm came from the west and its course was almost due east. There was very little rain and no hail, but incessant lightning, accompanied by a loud roaring noise. Quantities of timber and fencing were blown down, and the houses on four settlements destroyed or damaged. A man was killed and a woman severely injured. The violence of the storm seemed to be greater on the northern side.

We have no further record of this tornado in Alabama, but suppose it to be the one that afterwards was very destructive near Macon, Ga.

At Auburn, twelve miles north of the track of this storm, the temperature during the day ranged from 47° to 64°. The wind was southeast all day until 11 P. M. when it changed to the southwest, and a violent thunder storm passed over this place, with heavy rain fall lasting thirty minutes. The wind came

with a force of about twenty-five miles an hour; the electrical display was sublime, the lightning flashing in all quarters of the heavens, and the thunder rolling continuously. There was no hail at this point. The humidity for the day was 83 per cent.

A number of the Tornado Circulars, Nos. I, II, and III, issued by the Chief Signal Officer, were sent from this office, and the facts compiled from them are included in the above description of the tornadoes of the 11th. As they occurred in the night it was impossible to observe carefully the character and shape of the clouds.

An examination of the records for the day, from all the stations in the State, shows low barometer with temperature ranging from 45° to 65°, winds universally from the east and southeast, changing to the southwest as the tornado approached; after it passed blowing from the northwest with falling temperature. Very few observers report hail in connection with the tornadoes; and there seems to have been no electricity noticed that day until the tornado clouds were developed.

The Director desires to express his thanks not only to the regular observers of the Weather Service but also to the editors of the Collinsville Headlight, the Chilton Review and Eutaw Mirror, for valuable data furnished him in the preparation of the description of the destructive tornadoes of this month. He is also under great obligations to Mr. Thomas Bradford, of Centre, Judge W. C. Oliver, of Eutaw, Drs. W. H. Moon and C. M. Pope, of Goodwater, and Mr. I. M. Heard, of Tuskegee, for valuable information. In some instances parts of these reports have been copied literally, as in the case of the newspaper article written by Col. J. W. Taylor, and sent to the Director by Judge W. C. Oliver.

LITERARY NOTES.

Books, Reports, Etc.

'1) **Determinations magnétiques** *effectuées par la mission chargée de l'observation du passage de Vénus* **au Chile,** etc.

[In **Annales du Bureau des Longitudes.** 4°. Paris, Gauthier-Villars, 1883. Tome 3, pp. 365-506.]

Of the parties sent out by France in 1882 to observe the transit of Venus one party, under Lieut. De Bernardiéres, was sent to Chili. In addition to the labor immediately relating to the transit, this naval party engaged in other labors, some or all of which are reported in the *third* volume of Annals of the Bureau of Longitudes cited above. One work undertaken by this party was the determination of differences of longitude of several important stations on the western coast of South America. The second work undertaken was a series of absolute determinations of the magnetic elements at various stations chiefly in South America. Both these pieces of work are reported in the volume before us, but for present purposes the magnetic part of the work alone claims our attention.

The party was fitted out for magnetic purposes with *four* instruments, as follows:—

1. Portable magnetometer, by Brunner; for *all* the elements.

2. Theodolite magnetometer, by Hurlimann; for declination.

3. Dip circle, by Gambey—10 inch; for dip.

4. Vibration magnetometer; for horizontal force.

The first instrument is an universal one. With it are determined astronomical azimuths and also the magnetic declination, dip and intensity. The three remaining instruments were available for independent or check determinations. The Brunner instrument is figured and described, and appears to have given satisfactory results. The dip is determined with it indirectly. A soft iron bar placed *vertically* deflects the freely suspended declination magnet through an angle α; placed *horizontally* the same bar produces a deflection β, and the dip I is then calculated from the formula

$$\text{tang } I = B\frac{\sin \alpha}{\text{tang}\beta}$$

where B is a constant.

At many of the stations the dip was determined with both instruments 1 and 3, and, although there is in general a fair accordance, yet the values obtained in all such cases with instrument 1 are rejected and those of instrument 3 adopted. With the other instruments observations are made in the usual manner. Astronomical azimuths were generally obtained by observing the sun as near the prime vertical as practicable. Contacts were not made on the limb, but altitude and azimuth were *both* measured at once by bringing the image of the sun to the estimated center of a square formed by four reticules in the field of the telescope.

The results obtained, the methods employed, etc., are all set forth with great elaborateness, not to say diffuseness. The officers engaged in this work have shown zeal and diligence in securing results, and have secured a valuable contribution to our knowledge. At the same time a want of experience in such work is indicated in their published results. This appears in a certain want of perspective and precision in presenting results.

Observations began at Paris, before setting out for Chili, in May, 1882, and the first observations in foreign parts were made in July, 1882; the last were made in March, 1883, and observations at Paris, the base station, were repeated in July, 1883. A summary of results

obtained is found in the volume before us in three places, as follows: On page 350 we find: "Our separate observations in foreign parts are to the number of 50 for declination, 35 for dip and 40 for horizontal intensity at 35 different stations. On page 367 we find: "In *South America* were made 44 determinations of declination, 36 of dip and 41 of horizontal intensity; also 300 values of variation of magnetic elements were obtained at Cerro-Negro," the transit of Venus station. On page 370 we further find that "The determinations *in foreign parts* are: declination 44, dip 36, horizontal intensity 41; at 34 stations." These inconsistencies show a want of unity or of oversight in editing and publishing. The last summary appears to be the correct one. At the close of the elaborate discussion, tables of results are given, results for the three elements being given in separate tables. In this way the adopted values of the magnetic elements at the 35 (?) stations are made to cover about 50 4to pages. A single table embodying *all* adopted values for *all* the stations would, for most purposes, be so much more useful that we regret that it has not either supplanted or supplemented this long table.

In the results "adopted" the effects of diurnal variation have not been considered. A declination determined at 8 A.M. is "adopted" as the declination at that station. If the declination is observed at 2 P. M. all the same it is "adopted." At Valparaiso the declination was observed on the afternoon of Aug. 22, 1882, to be 15° 26′ E., and this value "adopted." It was again observed at the same station February 2, 1883, to be 15° 15′ E., and this value also "adopted."

The observations of variations of the magnetic elements at Cerro-Negro, to which allusion has been made, consisted in reading three instruments properly mounted, twice daily, once in the morning anywhere from 7 to 9 or 10 o'clock and once in the afternoon anywhere from 4 to 6 o'clock.

From the point of view of the "practical" navigator these results are excellent, superior even to first-class work; from the scientific standpoint or the standpoint of precision, however, they are inferior to first-class work, and must be set down as second-class. M. B.

Washington, D. C., Apr. 2, 1885.

(2) **Signal Service Notes No. xvii.** A first report upon "Observations of Atmospheric Electricity" at Baltimore, Maryland. Prepared under the direction of Brig. and Bvt. Maj. Gen. W. B. Hazen by Park Morrill, Private, Signal Corps, U. S. Army; Washington, 1884; 4 pages text and 6 sheets of automatic records.

In the latter part of November, 1883, Apparatus for the observations of atmospheric electricity was sent to the Johns Hopkins University, from the Chief Signal Officer, and put in charge of Private Morrill under the direction of Professor Rowland. This report gives the details of the first systematic efforts by the Signal Service to observe atmospheric electricity, and it is preliminary only, in character. The apparatus, which was of the form devised by M. Mascart of Paris, proved to be of defective construction and much time was spent in putting it in order and in experimenting upon a suitable source of light. Trouble was also met with in using the French photographic paper sent with the instrument, and from irregularities in the water dropping collector, as well as from defective insulation. These difficulties combined, led to the loss of so much time that the report contains the records for March and April, 1884, only.

The most important conclusions drawn by Mr. Morrill are: "The curves disclose, upon examination, continuous fluctuations occupying but a few minutes and ranging in value from ten to hundreds of volts. In comparing the electrical variations with other meteorological elements, we have no observations of the latter approximating in frequency these changes.*** The curves that give promise

of useful comparative study are those of temperature, humidity, rain and wind. The barometric variations are far too long in duration and seem to have no direct relation to the electrical changes. Similarly, with respect to varying cloudiness, there are the same continuous fluctuations of the needle on a perfectly clear day as with passing clouds. * * * There were, during March and April, fifteen rains of considerable amount—of these thirteen are preceded by a fall in potential of from 150 to 1000 cells. This fall begins from two to twenty hours before the commencement of rain. * * * There are also twelve slight rains of less than 0.02 inch, eleven of which are preceded by a fall in potential. * * * Hence we conclude that rain is preceded by a falling potential."

While this report can be regarded as but a preliminary and incomplete one, it is nevertheless of considerable interest because it deals with a subject so new to meteorologists.

The statement in regard to the fall of potential several hours before a rain (which is partly confirmed by other observers) will, if sustained by more complete observations, introduce an entirely new and important element with the science of weather predictions. L.

(3) **Alabama Weather Service.** Issued through the Department of Agriculture, Professor P. H. Mell, Jr., director, Auburn, February, 1885. The first year of the service is completed and the director comments on it as follows:

"It is just twelve months since the organization of the State Weather Service. In reviewing the work accomplished the director compliments the observers upon the large amount of valuable data they have collected by earnest and careful investigation. In some respects the year has yielded to the watchful observers material that has been highly prized by students of meteorology in other sections. The bulletins of the Service have been in demand and many have been circulated outside of the State among the scientists of the country. It is to be regretted that so few of the stations were able to present a continuous record during the year; but at the end of another annual period the director trusts that the list of complete records will be very largely increased."

"The Railway Signal Service has become an established fact, and the amount of good that has accrued to the people of the State wherever the flags have been raised cannot be calculated. Expressions of indorsement and hearty approval have been sent to the director from all sections, and many stations where signals are not displayed, have sent urgent requests to have the same favors extended to them."

The service is to be congratulated on the progress it has made. It publishes reports from 39 stations in this month.

The report contains a summary of the meteorological elements for the year.

H.

(4) **Meteorological Observations Made at Carson Observatory, Carson City, Nevada, during 1883 and 1884.** Charles W. Friend; 8vo.; 40 pp. The meteorology of Carson City is of unusual interest. It is 4,630 feet above sea-level and in the dry region between the Sierra Nevada and the Rocky Mountains. This pamphlet has therefore much of interest to meteorologists, and the interest is all the greater, in that Mr. Friend has done better than his title page promises; he gives the abstracts of observations from January, 1880. In the five years included, the minimum temperature was −18° (Feb. 13, 1884), and the maximum 100° (July 2, 1883), a showing by no means so bad as we would expect from common report. The annual mean temperature is 48°.3. The average annual precipitation is 11.90 inches which is quite small. The greatest precipitation is in March which averages 2.18 inches and December (2.34 inches). The precipitation in July, August and September is very small, averaging only 0.16

inch for each month or less than half an inch for the three. The prevailing wind is southwest, but it is not high, the greatest velocity recorded being 35 miles per hour (Feb. 15 and March 27, 1880). The number of clear days in the year averages 125. Frost has occurred in every month in these years except in July, 1883. Earthquake shocks were felt Oct. 21, 1881, 6:41 P. M.; Nov. 9, 1881, 10:8 A. M.; July 1, 1883, 3 A. M.; Aug. 19, 1883, 2:55 A. M.; April 11, 1884, 2:10 P. M. The last was accompanied by a loud report. H.

(5) **Illinois Monthly Weather Review, January, 1885.** Containing summary of meteorological observations made to the Department of Agriculture, Chas. F. Mills, secretary, Springfield. This is now published separately from the agricultural report and makes a neat pamphlet of 14 pages. The service has 21 reports represented in this review and appeals for more. It desires at least one in each county. The special phenomena and remarks are given separately for each observer, an arrangement very suitable for definite reference.

(6) **Report of the Ohio Meteorological Bureau, February, 1885.** T.C. Mendenhall, president; E. H. Mark, secretary; Columbus; 59 pp. Reports from 35 stations; thunder-storms on the 8th and 9th.

(7) **Report of the Tennessee Weather Service, February, 1885.** Also special report on the condition of the wheat crop and live stock. Issued by the Bureau of Agriculture, A. J. McWhirter, commissioner, Nashville; 24 pp. Reports from 39 stations. The lowest temperature reported was —4° on the 28th at Sunbright, Morgan county, 1350 feet above sea-level. At Nashville it was —0°.8 on the same day. Concerning this severe month in Tennessee, the director says: "At Nashville the average temperature was 10°.2 lower than the February normal. This has been the coldest February in fifty-three years. Mr. J. M. Hamilton, an old citizen of Nashville, reports a temperature of 15° below zero as having been observed on February 22, 1833. He further states that the temperature on that day did not go above 2° below zero, and that the day was cloudless; in that month much snow fell; the Cumberland was frozen to a depth of many inches, and heavily-loaded teams crossed over without any apparent danger."

(8) **Michigan Crop Report, No. 41, March 1, 1885.** Prepared and published by the Secretary of State, Lansing; 8 pp. Reports from 30 stations.

(9) **Monthly Weather Review, General Weather Service of the United States, January, 1885.** Prepared under the direction of General Hazen by Lieutenant James Allen, Washington; 26 pp.; 4 charts. To give some idea of the wealth of material employed, and the labor required, for the *Weather Review* we quote the statement of this review:

"In the preparation of this review the following data, received up to February 20th, 1885, have been used, viz.: the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and twenty-nine Signal Service stations and seventeen Canadian stations, as telegraphed to this office; one hundred and fifty-three monthly journals and one hundred and sixty-one monthly means from the former, and seventeen monthly means from the latter; two hundred and eighty-one monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the *New York Herald Weather Service;* abstracts of ships' logs, furnished by the publishers of *The New York Maritime Register;* monthly reports from the New England Meteorological Society, and from the local weather services of Alabama, Georgia, Illinois, Indiana, Minnesota, Missouri, Nebraska, Ohio, and Tennessee, and of the Central Pacific Railway Company; trustworthy newspaper extracts; and special reports."

Eleven atmospheric depressions were traced, of which six first appeared in the high Northwest, one near Lake Superior,

one in Kansas, one in Colorado and two in Texas near the Gulf of Mexico. Of these seven were traced over the Atlantic and two more found there which did not appear in the United States. The lowest temperature for the month was —50° on Mt. Washington, which is the lowest ever reported from that station; the next was —46° at St. Vincent, Minn. The lowest temperature on Pike's Peak was only —29°.4; the lowest ever reported from here is —37°. The last chart is an interesting one, giving departures from normal pressure and temperature for the month.

H.

CORRESPONDENCE.

FALLACY OF POPULAR WEATHER-PROVERBS RELATING TO THE MOON, WITH SOME PREDICTIONS.

To the Editor:—In 1883 a collection of about 500 proverbs was published under the direction of the Chief Signal Officer of the army, for the purpose of bringing them to the attention of scientific men, but not to be considered as indorsed by him. Many of them are of scientific character, but those of the least value appear to be the most popular.

Almanacs having a large sale, contain predictions that I am quite sure are based entirely on Herschel's* Weather Table. Now, if the moon has any influence on the atmosphere, it should attain its maximum during a solar eclipse. But if an eclipse happens near midnight, it will not, according to the table, create any disturbance, but if a lunar conjunction occurs near midday it will cause a disturbance, whether it is an ecliptic conjunction or not. I might give some reasons why it should not be depended on.

Herschel's table and the following five proverbs are from the collection mentioned above.

"New moon far north in summer, cool weather; in winter, cold."

According to that proverb we should always have cool weather in summer, but never in winter, because the new moon is always south in winter.

"When Luna first her scattered fear recalls,
If with blunt horns she holds the dusky air,
Seamen and swain predict abundant showers." (*Virgil.*)

The bluntness of the horns simply indicates the state of the atmosphere then existing between the moon and the observer. I have seen the horns both blunt and sharp on the same evening, and followed sometimes by wet, and often by dry weather.

"If the new moon appears with the points of the crescent turned up, the month will be dry, if the points are turned down, it will be wet."

If that is correct there will always be dry weather in middle latitudes during March and April, and dry weather at the equator all the time.

"The further the moon is to the south the greater the drought; the further west the greater the flood, and the further northwest the greater the cold."

If *new* moon is meant, then we should have the greatest droughts in early winter, and the greatest cold in early summer. But if new moon is *not* meant then droughts, floods, and cold weather should occur in the same locality every month.

*This well-known table is not the work of the celebrated Herschel's, (see Sir John Herschel's *Familiar Lectures*, p. 147), and any authority they may have derived from their name is entirely factitious. [Editor.

"New moon on its back indicates wind; standing on its point indicates rain in summer and snow in winter. (Dr. Menual.)

The first part of that proverb appears to be correct because the new moon is always "on its back" in March, but we all expect March to be a windy month without waiting to see the moon. If it would apply to all localities, cyclones would be the most frequent and the most violent in the equatorial regions. The moon does not stand on its point in March yet we often have rain in April.

The following table shows the distance of the moon from the equator at Greenwich mean noon of the first day after the change:

Months.	1845.		1881.		1882.		1883.	
	D.	Declin.	D.	Declin.	D.	Declin.	D.	Declin.
January	9	S. 14°	31	S. 6°	20	S. 18°	10	S. 14°
February	7	7	29	N. 3	19	N. 1	8	7
March	9	N. 5	30	11	20	9	10	N. 6
April	7	12	29	21	18	16	9	13
May	7	20	28	28	18	21	8	18
June	6	20	27	20	16	20	7	19
July	5	17	27	11	16	14	6	16
August	4	12	25	3	14	7	5	8
September	3	1	24	S. 9	13	S. 4	4	1
October	2	S. 11	24	19	13	14	2	S. 10
November	31	16	22	22	11	19	31	15
December	30	20	22	19	11	20	30	19
	29	18					30	17

NOTE.—The 1st of March is dated Feb. 29th for convenience.

While I believe that most of the moon proverbs are worthless, I am compelled, after many years of investigation to admit that the moon when in certain positions has a slight influence on the weather. Some meteorologists do not regard the moon in any light except moonlight, but it appears to me if it was created merely to give light, it would have been placed on the celestial equator and in opposition to the sun; and all the inhabitants of the earth would have enjoyed the light of full moon every night from sunset till sunrise. I am also compelled to believe that the planets when in certain aspects to each other and to the sun have an effect on the weather. It is admitted by all that when the sun crosses the earth's equator it causes equinoctial storms. I contend that when the sun crosses the equator of any other planet, and that when the earth or any other planet crosses the sun's equator, effects not very dissimilar will follow. I have carefully considered the planetary phenomena coincident with the dates of Sergeant Finley's Six Hundred Tornadoes, extending from 1791 to 1882, and find that certain aspects of the moon and planets not mentioned in any weather theory that I have seen, have a strong tendency to produce violent atmospheric disturbances, while other phenomena such as solar conjunctions of the superior planets appear to have no influence whatever.

It was not my intention to treat upon this subject, not having completed my investigations, but I will add that the dates that appear to me most likely to be attended with local and violent storms and tornadoes during the next four months are: June 5, 13, 19, 23 and 27th in western states and Indiana, and Ohio. April 6th and 26th, in the west and south. July 3d, 13th, 17th and 23d, in Minnesota and Indiana to New York. May 16th, 23d, and 28th to 31st, in the west. The dates least likely to be attended with tornadoes are: May 8th 13th and 19th. July 7th, 20th, 27th and 31st. April 2d, 9th, 14th and 20th. June 8th, 16th and 30th.

If tornadoes occur much nearer to the dates in the first group than to the dates of the latter group, my theory, though yet undeveloped, will perhaps be worthy of the consideration of scientists.

JAMES G. BARDSLEY.

NEPHI, UTAH, March 14th.

ANOMALIES OF CLIMATE NEAR LAKE CHAMPLAIN.

TO THE EDITOR:—With regard to the difference in the beginning of winter and the opening of spring in Dakota and Michigan, I infer that it is due to the influence of the Great Lakes around Michigan and the absence of those large bodies of water in Dakota.

Here in the Champlain Valley, which lies between two lofty chains of mountains, these items are much observed, and the difference between the Champlain Valley, and the Connecticut Valley with only the Connecticut River, is great, as you can notice by signal service records. Here in Charlotte it has been noticed for years that only three miles back from the Lake spring opens, trees leaf, flowers bloom, two weeks earlier than at the Lake, and in the fall frost and snow come two weeks earlier than at the Lake, yet the difference in the soil is much; at the Lake it is lime-stone soil, while up here it is clay. The lime land works almost or quite as easily as the clay; it drains naturally sooner. Lake Champlain is called, by all who know it and its influence on the atmosphere, a great heating reservoir; it makes this valley far more productive than it would otherwise be, for fruit especially. People coming from the Connecticut valley look with amazement at our fruit products, grapes especially, and wonder why they never have any over there.

There are no lofty mountain chains between the Rockies and Michigan which may account for the unbroken advance of the different areas you mention as passing with such regularity. You will notice that the two weeks between Dak ota and Michigan, is noticed here in just three miles. The difference in the temperature for the month of February last, in this same three miles, or Burlington and this station, was 3°. At Burlington the temperature of February last was 12° here, 9°.

The areas of cold pass from the north to the south here. We look to Canada for the commencement of cold periods, but I have *not* noticed particularly as to the time of transit. I think the time nearly the same as you mention. In the fall we see the wild geese go south, we know they are a few days in advance of the first freeze up; rain passes from west to east here almost always.

Respectfully,

MINERVA E. WING.

CHARLOTTE, VT., March 31, 1885.

STORM OF DECEMBER 22ND.

TO THE EDITOR:—My communication of the 14th inst. having been written under pressure of limited time, I omitted to notice an important feature in the storm of December 22d last, as follows:

About the time that the conical mass of vapor forming beneath the cloud, was observed, it was also noticed that a phalanx of detached masses of stratus clouds was scudding up from the south, and that they appeared to mingle with, and lose themselves in, the lowest portion of the long thunder cloud. At the same time it was also noticed that these stratus masses appeared to issue from a marked, well defined line, running from southwest to northeast, or from west-southwest to east-northeast, and that this line instead of drawing nearer, along with the detached clouds springing from it and hurrying along at the rate of fifteen to twenty miles an hour, on the contrary was continually receding to the southward, which southward movement corresponded very closely with the advancing movement of the thunder-cloud. Was not this condition of things, the intermingling of these clouds moving from different directions, favorable to the evolution of thermo-electricity? Let us suppose that it was, and that currents of such electricity began to circulate and to increase in intensity along with the progressive increase of the atmospheric disturbances, until the crisis was reached and the winds united in their wild whirling movements, their death dealing dance. Would not this rapid gyratory

movement of the air loaded with mist and vapor be communicated to the electric currents, and would not these currents soon derive magnetic properties from the spiral movement? That the forces should be developed in the above order seems to me not at all improbable, and if the mode of the magnetic circuit in displaying its force in the area within the circuit corresponds with the order in which I have always found the trees in tornado tracks to be prostrated, that is, beginning at the east and proceeding round both by the south and by north till the two streams of action meet in the west, then I will be convinced that all the forces brought to bear in the operations of the tornado are to a greater or less extent subject to the controlling and guiding influence of magnetic electricity. During and after the passage of the storm in the three tornadoes which have occurred in my vicinity within the last two years, the thermometer has indicated but little change in the temperature until the lapse of six or more hours after the storm has passed by.

Yours truly,

W. W. ANDERSON, M. D.

STATESBURG, S. C., March, 18, 1885.

UNUSUALLY BRILLIANT MOONLIGHT.

TO THE EDITOR:—On the night of the 24th of March the moonlight, as noticed at this point, was of more than ordinary brilliancy. Dr. A. F. Whelan of this city, a man of long years of practice, a close observer, and one who is thoroughly interested in scientific or natural phenomena, corroborates my testimony by saying that it was the most intense moonlight that he has seen for twenty years (and in that time he must have had many a moonlight ride). He said it seemed like an electric light, for color and brilliancy. He also said that as he rode along the road, out of the city, in answering a professional call, the moon repeatedly passed from behind light clouds, bursting forth, as it were, with such a flood of light as to make it easy for him to tell the time, to the very second (by that hand) from his watch, and lighting up the track with wonderful distinctness for more than twenty rods ahead. Not only was the light unusually brilliant, but it seemed to be uniformly diffused. The sunrise the following morning was also especially noticeable for its unusual brilliancy and colors.

Prof. Geo. B. Gardner, of the Art Department of Hillsdale College, was much interested in observing it.

A. E. HAYNES.

HILLSDALE COLLEGE,
HILLSDALE, MICH.

PECULIAR LUNAR PHENOMENON.

TO THE EDITOR:—On the morning of March 30th at 4:45 my attention was attracted by a very peculiar appendage to the moon. Surrounding the lunar disc was a narrow ring of beautiful soft yellow light; while extending upwards vertically from the moon's disc was a shaft of the same soft light about five lunar diameters in length and about the diamter of the moon in width. This object was very well defined at its edges and fairly conspicuous. Obscuring the moon behind a house top the object was clearly seen in relief against the sky. There was considerable cloudiness in the west below the moon, but none above it; the sky was fairly clear and free of haze; the morning pleasant, not cold. The object strongly reminded me of the solar corona that I have seen in some drawings. I am not certain that it did not extend below the moon also, as clouds soon obscured the view, though I think it extended only above. I take it for granted this was some peculiar freak of refraction.

E. E. BARNARD.

NASHVILLE, TENN.